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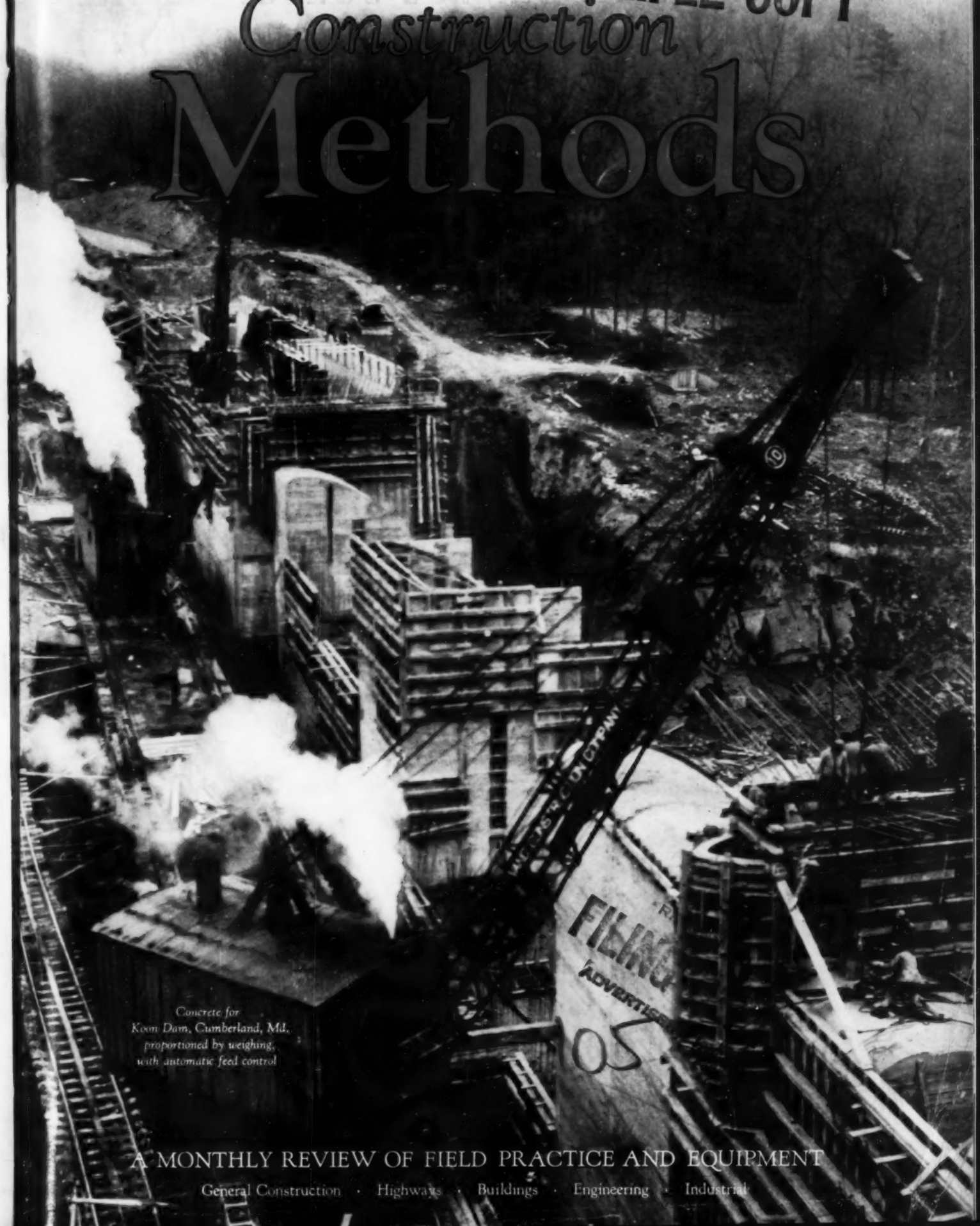
March
1932

Construction Methods



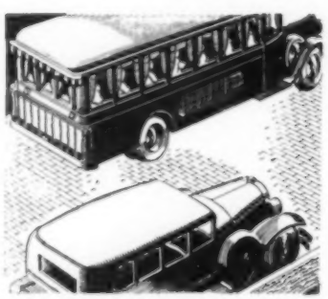
Concrete for Koon Dam, Cumberland, Md., proportioned by weighing, with automatic feed control

A MONTHLY REVIEW OF FIELD PRACTICE AND EQUIPMENT

General Construction · Highways · Buildings · Engineering · Industrial

BUILT AFTER A CAREFUL SURVEY OF THE TRAFFIC EXISTING AND PROJECTED . . .

Richardson Road in Dallas County, Texas . . . 11.6 miles paved with Vitrified Brick in 1924



RICHARDSON ROAD in Dallas County, Texas, represents the result of sound engineering principles scientifically applied. Leading north from the city of Dallas, it carries most of the through traffic to cities in north Texas, Oklahoma and other northern and eastern points. Traversing a rich agricultural region adjacent to a large city, this road also carries heavy local traffic. ◪ The precinct Commissioner and the County Engineering Department took time to make a careful survey of the type and amount of traffic *both existing and projected.* After examining all facts surrounding the project, it was apparent that the economics of the situation required a type of pavement that would be durable and free from repairs. A vitrified brick-surfaced pavement was specified for the section of 11.6 miles from the city limits of Dallas to the town of Richardson. That was in 1924. To date there has been practically no expense for surface maintenance. ◪ Modern Brick-Surfaced Pavements should be specified whenever and wherever a careful survey of the traffic . . . *existing and projected* . . . demands a pavement that will stand up and keep repair costs down.

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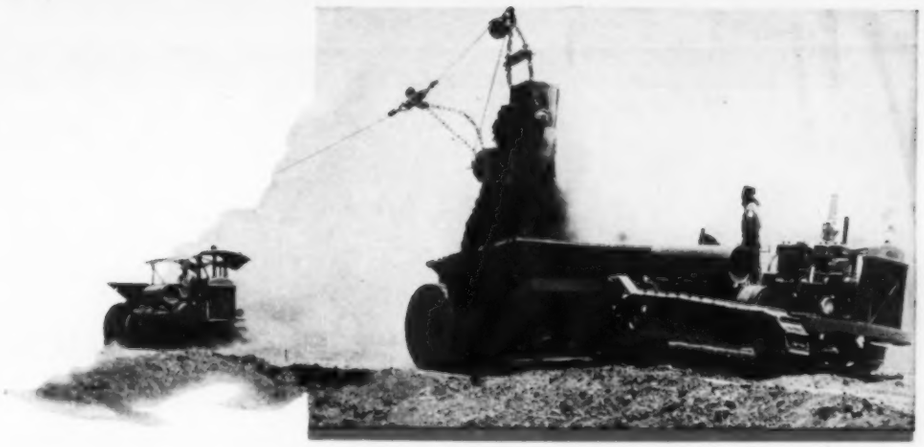
CONSTRUCTION METHODS, March, 1932. Vol. 14, No. 3. Published monthly. McGraw-Hill Publishing Company, Inc., 330 West 42d Street, New York, N. Y. $1 per year. Foreign, $2 U. S. Currency, or 10 Shillings. Canada (including Canadian duty), $1.50. 10 cents per copy. Entered as second-class matter, October, 1926 issue, Vol. 8, No. 19, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

The Editor Notes -



CONSTRUCTION METHODS

A monthly review of modern construction practice and equipment

ROBERT K. TOMLIN, *Editor*

Editorial Staff

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McGraw-Hill Publishing Company, Inc.
330 West 42d St., New York, N. Y.

Developments in Brick Paving

THE proceedings of the annual meeting, last month, of the National Paving Brick Association indicate several improvements in brick paving practice:

(1) To overcome objections caused by the film of excess joint filler squeegeed on the finished surface, whitewash has been applied, before pouring the joints, to prevent adherence of the bituminous material to the top of the brick. The bond-breaking whitewash coat permits excess filler to be scraped off readily and reused, in part.

(2) In concrete base for brick pavement, joints, both transverse and longitudinal, are being used more extensively. Unjointed bases have developed cracks into which sand from the cushion course filters, causing unevenness of the paved surface. The base with bituminous-filled joints prevents loss of cushion sand.

(3) Thinner cushion or bedding courses—from $\frac{3}{4}$ to 1 in.—and greater uniformity in the depth of these courses are in favor.

(4) To prevent "bleeding" in hot weather, harder bituminous fillers.

To Stimulate Repair Work

The first of the "follow through" organizations growing out of the President's Conference on Home Building and Home Ownership has been set up in the committee on reconditioning, remodeling and modernizing. This committee will cooperate with the division of housing of the Department of Commerce. The committee is undertaking a broad campaign through local committees looking to the stimulation of remodeling work with the object of providing employment for construction workers.

To handle this kind of work, one large general contractor in the West has formed a subsidiary company to engage exclusively in the business of building repairs and alterations, no matter how small. Payments for the work done by this organization may be spread over a period of 12 months. To stimulate new business and to keep his men on the payroll, this contractor pays to any of his own employees a commission for information that leads to an order for house repair or alteration work. Up to the present, contractors, as a class, have shown little of the alertness in developing new markets for their products or services that has characterized the activities of industrial organizations.

Improved Methods of Placing Reinforcement

While sled runners, dragged behind the paving mixer to aid in placing wire mesh reinforcement for concrete paving, have been used (as described in *Construction Methods* for November, 1931, pp. 35-37), experience has indicated a number of objections to the method, among others, delay to paving operations and aggregate separation, with resulting planes of weakness in line with the runners. Current practice, as reported by the Wire Reinforcement Institute, favors the "cable-to-finisher" strike-off method, pictured in a series of step-by-step illustrations on pp. 42 and 43. This recent development employs the finishing machine to operate the strike-off template and insures accurate positioning of sheet reinforcement without delaying the progress of the mixer.

Accurate Control of Concrete Mixes

CONSTRUCTION of the Thomas W. Koon dam at Cumberland, Md., described on pp. 18-23 of this issue, is notable for the methods and the equipment that the Vang Construction Co. is using to insure accurate weight measurement of the ingredients entering into the concrete mix. The main features of the system by which aggregates and cement are correctly proportioned are improved weighing devices, automatic feed control with cutoff of supply actuated by a photo-electric cell, and a permanent graphical record of the ingredients of each concrete batch. During recent years great progress has been made in the scientific design of concrete mixes. This advance in theory, however, is sometimes nullified in practice by haphazard or inaccurate field methods or equipment. The proportioning set-up on the Koon dam job, therefore, is a step toward the production of better concrete.

No Preferential Contract Awards

In a paper presented before the recent annual convention of the American Association of State Highway Officials, Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, speaking of policies that would be acceptable to the bureau said: "A restriction which the bureau will not accept is any disbarment of a contractor from the award of a contract because he is a non-resident of the State, provided he is the lowest responsible bidder. The Federal Government consistently maintains the principle of the award of contracts to the lowest responsible bidder, and this is the only defensible public policy. . . .

"The bureau will not accept restriction or limitation to materials, etc., produced only within the State."

What Price Economy

ALL over the land merchants, manufacturers and bankers are looking hopefully to the day when the consumer's dollars will come trooping into the market place in greater numbers; they are watching for the "revival of business." But business must wait upon the buyers, i.e., the consumer with dollars to spend

The consumer's dollars are born of his earnings, either as wages, salaries, interest or dividends. And during the last year or more private business has been a bit shy on earnings. So consumers' dollars from that source have been rather scarce. Then, too, it is difficult for private industry, especially the manufacturer of consumer goods, to pay out more wages and salaries without at the same time producing more goods that must be bought.

But the construction of public works has been providing the wherewithal to keep a lot of consumers in the market place, and to do it without producing any more goods to be bought. In other words, the public works programs have provided a most helpful back-log of buying power during the recession of private industry.

Now, we are told by some of these merchants, manufacturers and bankers that we should suspend or curtail our public works construction. They want to "slash governmental expenditures." *They do not distinguish between administrative expenses and capital investments.* They just want to "cut the cost of government", to stop the provision of essential community facilities, to add to the roll of the unemployed some more of the consumers who still are able to buy their goods. And all this is to "reduce the burden of taxes."

Well, are taxes going to be less burdensome when they are collected to pay a dole than when they are applied to the employment of consumers in the creation of useful and permanent improvements?

Willard Chevalier

Publishing Director

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Whether it's oozy gumbo, treacherous quicksand or just plain dirt, Universals will dig it profitably. A typical job is illustrated — 18 ft. of tough Ohio clay, an old concrete culvert, twisted steel reinforcing rods — the Universal digs in and out they come. Just one of a hundred applications for this combination clamshell, dragline and crane unit with its mobile mounting, capable of transporting it quickly into open country or maneuvering it easily through busy city traffic.

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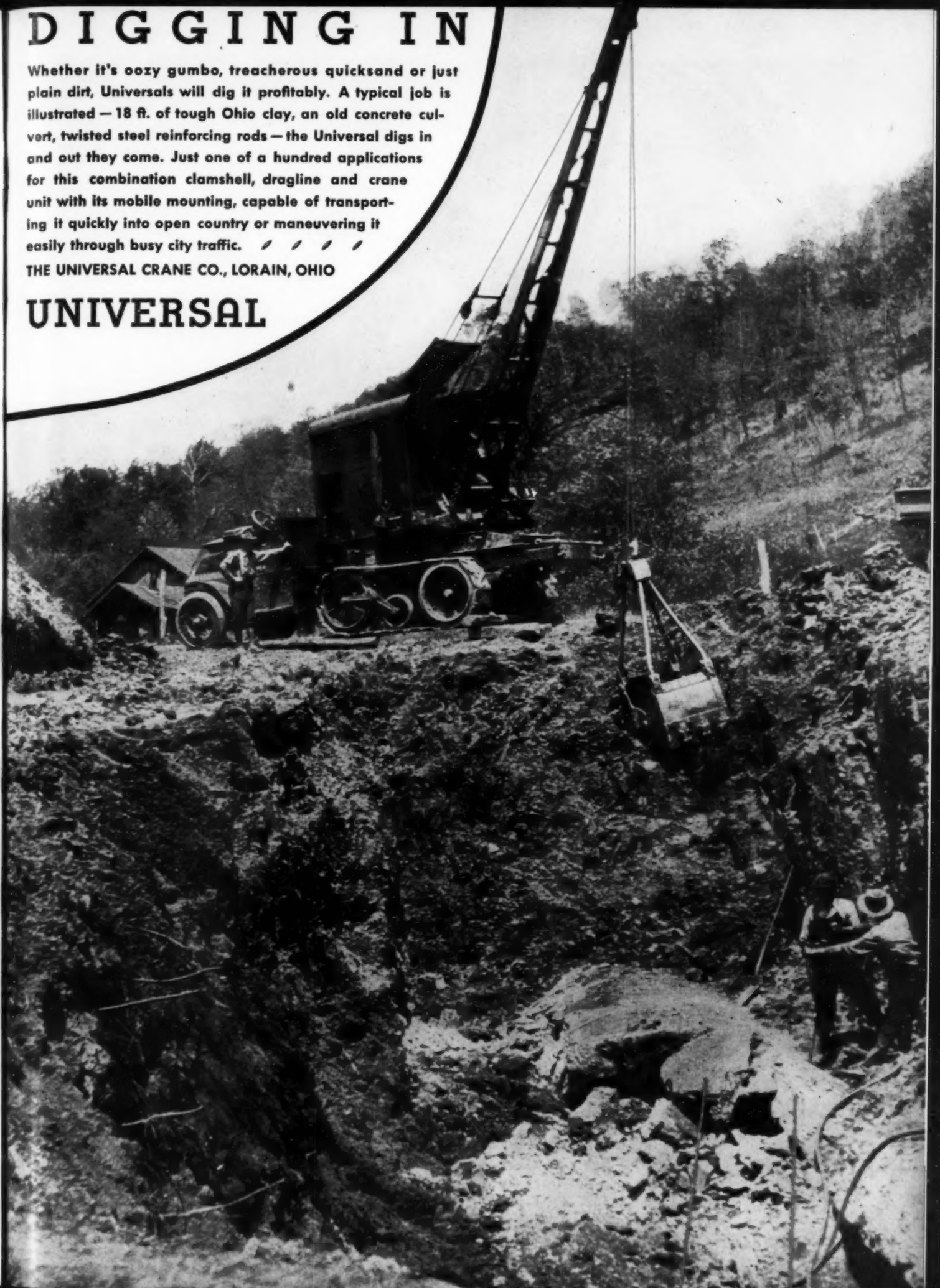

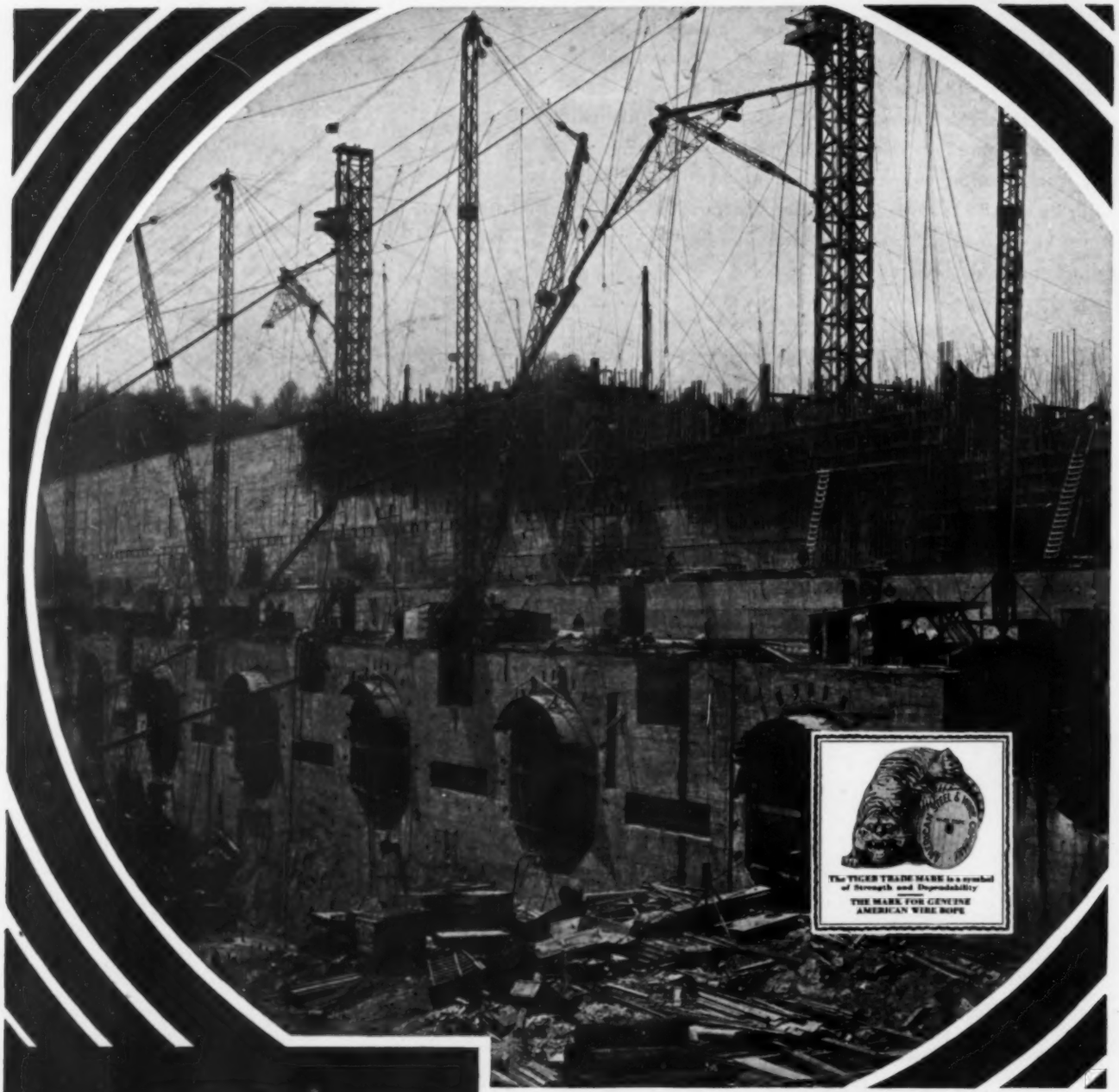

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Close to a half million feet of American Steel & Wire Company Monitor Silver Strand Wire Rope was used in connection with the vast project which is portrayed in the illustration. This enormous amount of Wire Rope included many different grades and sizes—and its application to various types of equipment was carefully supervised by our engineers.

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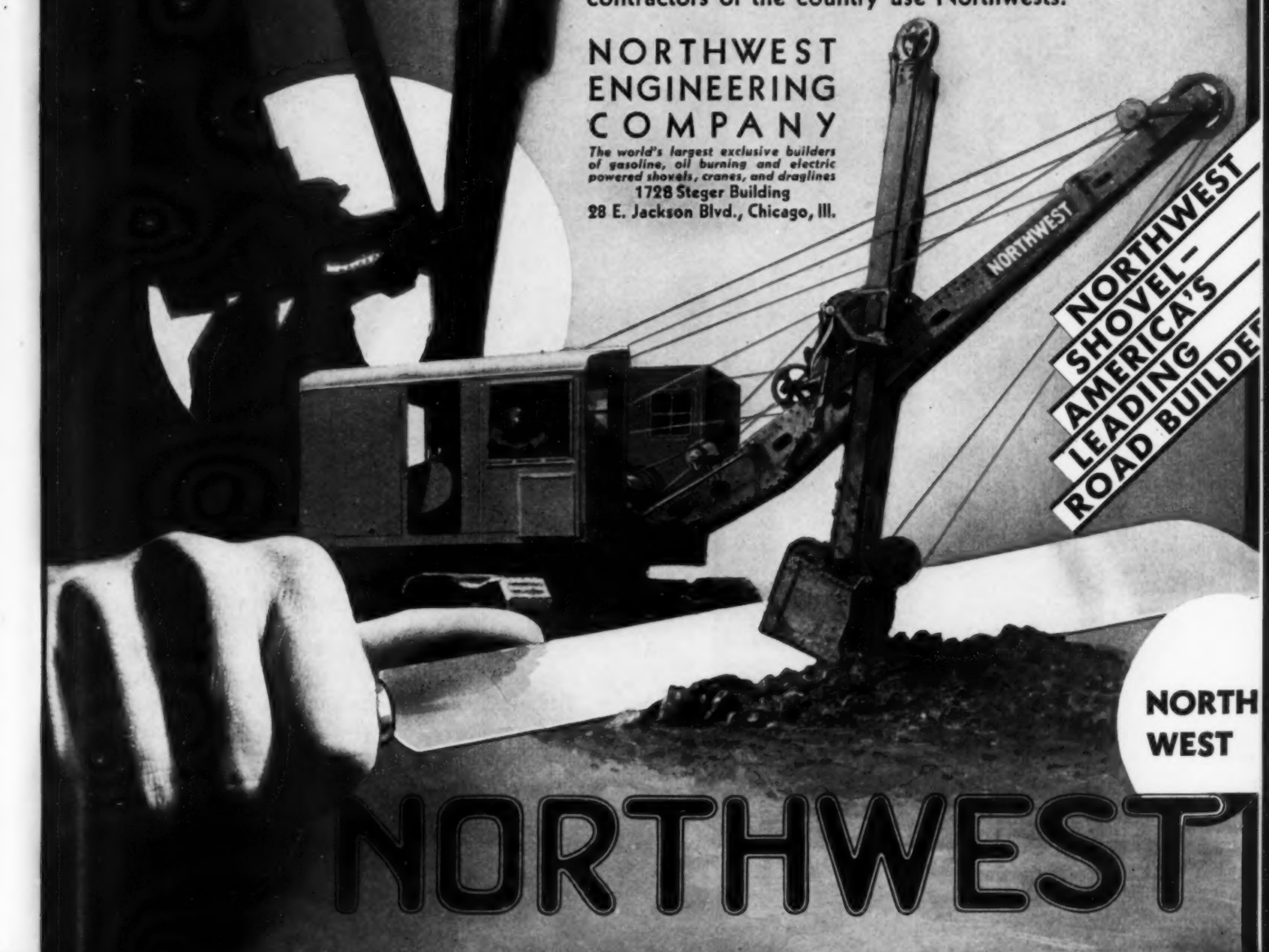


NORTH WEST

NORTHWEST

136 Berwyn Retailers

THURS. — STREET READY FOR TRAFFIC

WED. — CONCRETE POURED

One of 67 Jobs Described in
"New Facts About 24-Hour Cement"

All the facts about this street repaving job in Berwyn, Ill., are given briefly but clearly in the book, "New Facts About 24-Hour Cement," shown on the opposite page. This book also contains facts about actual savings on 66 other 'Incor' Jobs, with photographs and construction data. Only 87 copies. Your 'Incor' man has one. Let him show you proof of what 'Incor' has saved for others —can save for you on the jobs you have in hand.

Save 20% to 85% Loss of Sales

How 24-hour cement makes this possible

Oak Park and Berwyn are prosperous suburbs of Chicago. Roosevelt Road divides the two.

The narrow strip of highway between the car-track and the Berwyn side (see photograph at left) was to be repaved, while through traffic was maintained on the Oak Park side.

Repaving was planned with ordinary Portland cement. Excavation started. Barricades were thrown across the Berwyn side of the street. Immediately sales dropped from 20% to 85%.

Berwyn Merchants Demand Relief

136 Berwyn store owners found business virtually paralyzed. They demanded prompt action.

As a result, 'Incor' the 24-hour cement was used instead of ordinary Portland cement. 'Incor' placed one day is ready for traffic the next.

Traffic and business came back—seven days sooner than would have been possible with ordinary cement—bringing with it a saving to merchants many times greater than the slightly added cost of 'Incor'.

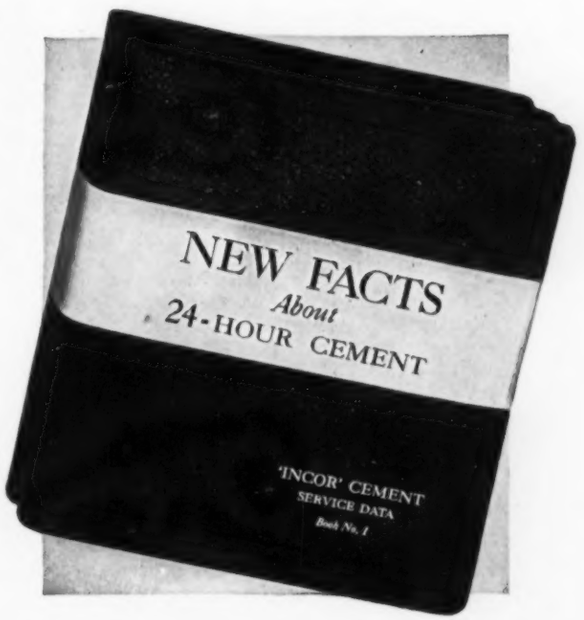
This is one of hundreds of cases where merchants save *utterly unnecessary* trade losses. Traffic experts place these losses at a total of $300,000,000 a year.

67 Examples of Saving

This book, "New Facts About 24-Hour Cement," shows in dollars and cents the economies effected on all types of work where cement is a factor.

For 9 cases out of 10 there is a close parallel. Only 87 of these books have been printed. They contain the most striking information on cement performance ever published.

"New Facts about 24-Hour Cement" contains fact-stories of actual savings and economies in Highways, Municipal Paving, Bridges, Viaducts, Railroad Work, Tunnels, Water Tight Structures, Concrete Buildings, Piling, Sewers and other types of concrete work.



An 'Incor' man will be glad to show you this new book—give you facts about the kind of work in which you are interested—how you can effect important savings with 'Incor'* 24-Hour Cement.

Write to the nearest Lone Star Company, listed below. There is no obligation.

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The Lone Star Cement Co. (Kansas).Kansas City, Mo.
Lone Star Cement Co. Louisiana.....New Orleans
Lone Star Cement Co. New York, Inc.....Albany
Lone Star Cement Co. Pennsylvania...Philadelphia
Lone Star Cement Co. Texas.....Dallas
Lone Star Cement Co. Virginia, Inc.....Norfolk

*Reg. U. S. Pat. Off.

'INCOR' *24-Hour Cement*

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"WITH reference to the K-38 Combination Crane and Shovel which we purchased last May, we wish to advise that when the machine arrived, we used it as a shovel, and in 11 hours, we averaged as high as 1500 yards per day for a period of 7 months on a 280,000 yards excavating job. After that it was converted to a crane and we have been using it on our bridge job to drive piling with a 9B2 McKiernan-Terry hammer. We have had the machine for 14 months and the actual cost for parts has been $7.30, which included 4 spark plugs and 1 small pin.

"We have used every other make of crane and shovel within the last 25 years since we have been in business and we are convinced that the Link-Belt Crane and Shovel is the best piece of equipment that we have ever owned." S. S. Thompson & Company, General Contractors, Red Bank, N. J.

For heavy duty from ¾ to 2½ yds. capacity —the Link-Belt shovel-crane-dragline is the world's low cost machine figured on the basis of the cost per yard of dirt moved.

LINK-BELT COMPANY
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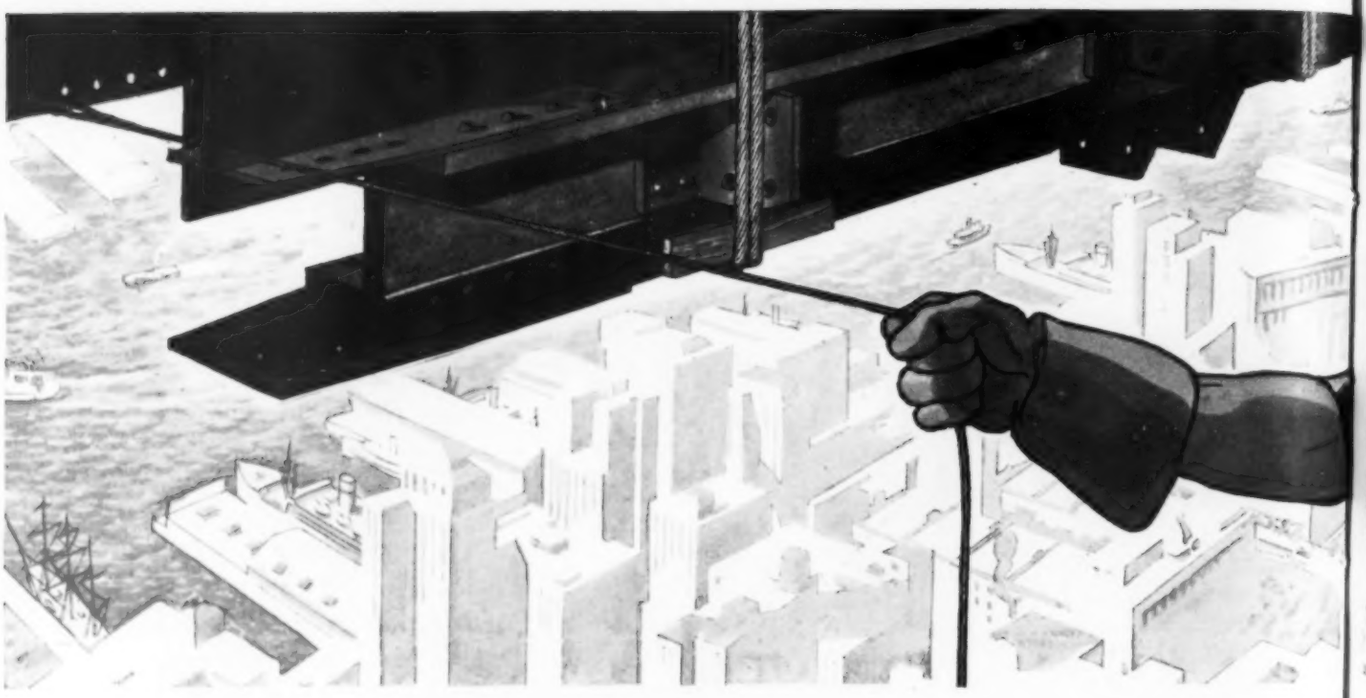

IT'S TIME FOR STRAIGHT

on this matter of Wire Rope Service

•

Today, perhaps more than ever before, the subject of wire rope service or "life" is engaging the attention of wire rope users.

This is a healthy sign. For wire rope *should* be evaluated on a dependability basis. Its economy *should* be judged from the standpoint of its cost per ton of material handled, per miles of travel, or other unit of service measurement.

It is well to remember, however, that many factors, quite apart from the inherent quality of a wire rope, affect the service it gives. One is the skill of the operator. Another is the operating conditions. A third is the condition of the equipment. A fourth is the care the wire rope receives.

These four factors vary from time to time — often greatly — and the life of the wire rope used varies accordingly.

It follows, therefore, that the economy

ROEBLING

THINKING

of wire rope should be determined on the basis of *average* service—not the performance of a single rope.

Average service is the only fair and reliable—and is the most exacting—basis on which to compare the service of wire ropes. To have its ropes put to this most critical test is an opportunity always welcomed by Roebling.

•

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A plain statement about Wire Rope Economy

Roebling does not indulge in nor encourage sweeping claims of superior wire rope economy. Such claims, if generally made, would merely confuse the rope user.

For the guidance of rope buyers, however, Roebling does assert that *when gauged by the work performed, NO wire rope,* regardless of make or construction, *will show lower general average operating costs than Roebling.*

Wire Rope for all purposes

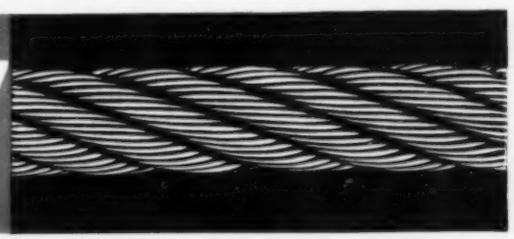
There is no such thing as a wire rope "cure-all". No *one* design of wire rope is suitable for *all* purposes.

Roebling makes wire rope of a great variety of types and constructions, and therefore can supply a wire rope exactly suited to each particular requirement.

The great stamina of all Roebling Ropes is primarily due to the *quality* of Roebling Wire. This Acid Steel Wire is renowned for its fatigue and wearing qualities. No better rope wire is produced.

"BLUE CENTER" STEEL is the highest grade and is generally recommended for severe duty.

WIRE ROPE



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Without changing any of the operating machinery THE GENERAL EXCAVATOR can be fitted, in the field, with the boom assembly best suited for any particular job.

The GENERAL EXCAVATOR is as nearly perfect as broad experience, advanced but proven design, modern manufacturing methods, good materials, and skilled workmen can make it. Approximately 90% of the machine's weight is of steel, generously ribbed and braced.

The GENERAL is noted for its great STRENGTH, SPEED, POWER and CAPACITY. Powered with a 62 Horse Power six cylinder gasoline engine. It has a single line pull of 12,000 pounds. Compare THE GENERAL point by point with others and you will be surprised at the number of exclusive features offered.

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General EXCAVATORS

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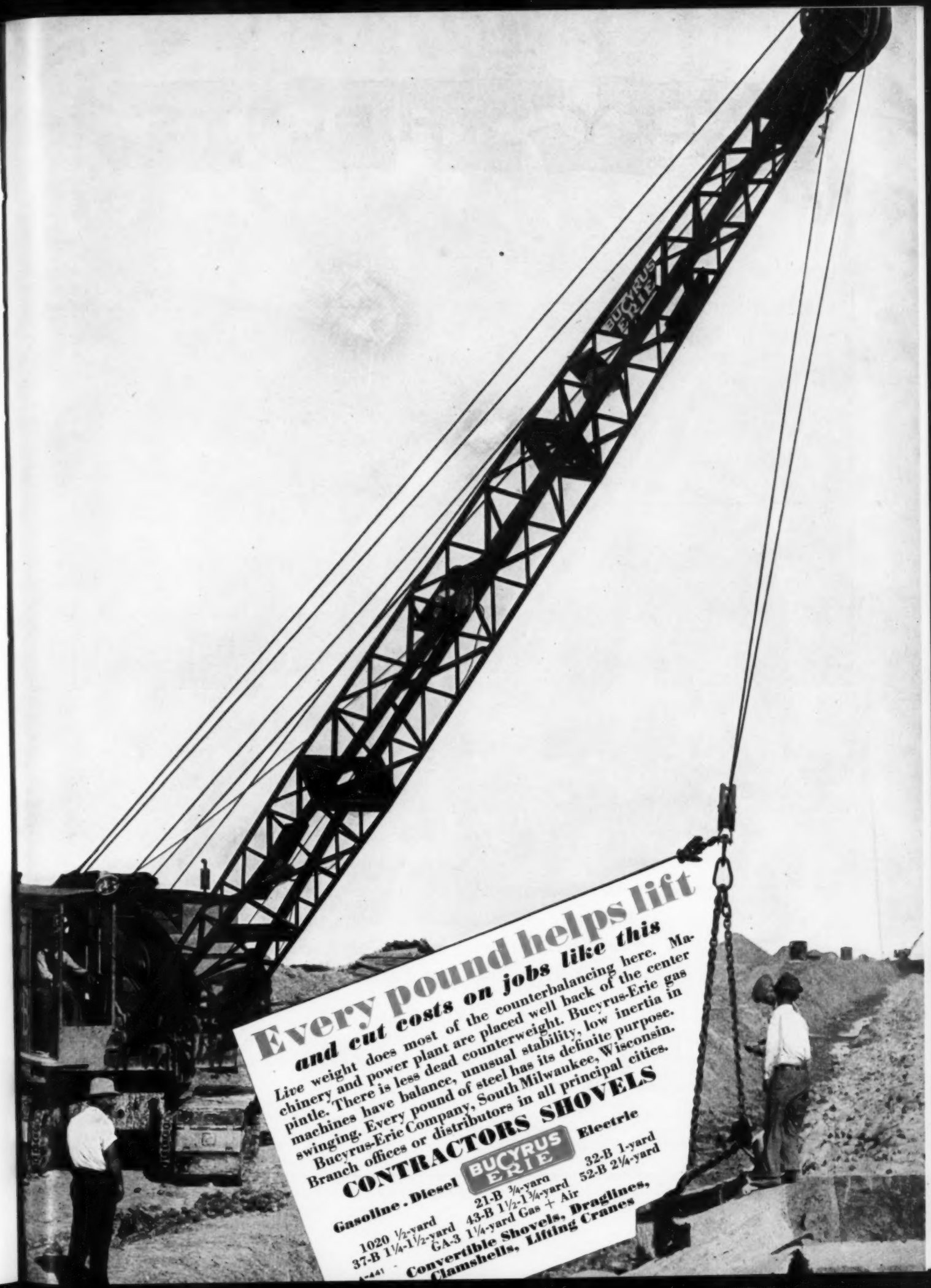

Every pound helps lift *and cut costs on jobs like this*

Live weight does most of the counterbalancing here. Machinery and power plant are placed well back of the center pintle. There is less dead counterweight. Bucyrus-Erie gas machines have balance, unusual stability, low inertia in swinging. Every pound of steel has its definite purpose. Bucyrus-Erie Company, South Milwaukee, Wisconsin. Branch offices or distributors in all principal cities.

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Convertible Shovels, Draglines, Clamshells, Lifting Cranes

A-441

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Having acquired the business of the Dayton Whirley Company, formerly fabricators of Wiley Whirleys, the Clyde Iron Works extends to the present and future owners of these machines, its manufacturing facilities and established service. Known in the future as Clyde Wiley Whirleys, these machines will be manufactured completely by the Clyde Iron Works and distributed exclusively by the Clyde Sales Company.

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Construction Methods

ESTABLISHED 1919—McGRAW-HILL PUBLISHING COMPANY, INC.

ROBERT K. TOMLIN, *Editor*

VOLUME 14 NEW YORK, MARCH, 1932 NUMBER 3

CENTER COLUMN HAZARD to night traffic using highway underpasses in Ohio is eliminated by efficient lighting.

UNDERPASS ILLUMINATION

Prevents Traffic Accidents

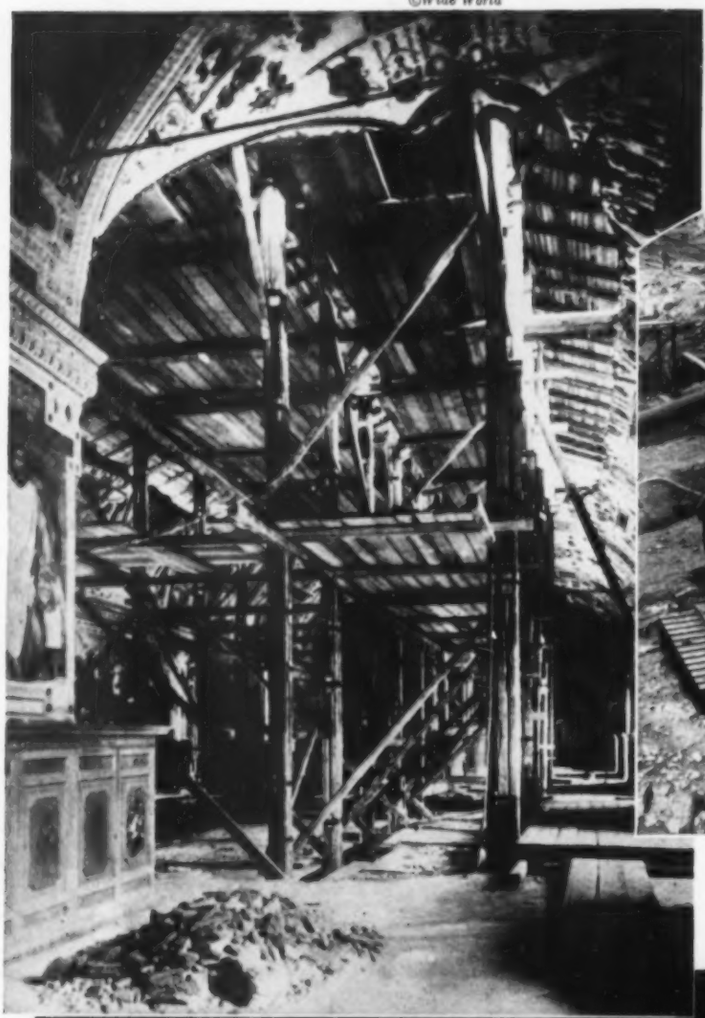
AS a safety measure, the Ohio state highway department has developed a bridge lighting system for those underpasses (where roadway extends underneath railroad tracks) having a center support in the middle of the pavement. While the state favors a design of underpass which does not have this middle supporting column, the fact remains that there are a number, built in previous years, that now exist on the state system of highways.

For the type of grade separation which has the center support a night lighting system has been devised, so that the motorist can easily discern at a reasonable distance the center column of the underpass and thus avoid colliding with it. The illumination is accomplished with a hexagonal lantern, using a 100-watt electric light bulb. This lantern is mounted on the superstructure or on the side of the span and located in the center. Three openings about 6 in. in diameter are in the lantern, two on the sides and one on the bottom. Mounted in these openings are refractional lenses that deflect the beams of light out on the sides of the spans and upon the center column. Sufficient light is thus produced to warn the motorist of the approach to the underpass with the center support.

Only one lantern on each side of the bridge is necessary, and the cost of installation is borne by state, county, city and railroad according to the proportionate expense of the grade separation. Before installation is made the state requires that a contract be entered into between the state and county or city, whichever it happens to be, to supply the current and maintenance of these lights. This contract is filed with the state highway department of Ohio.

This Month's "News Reel"

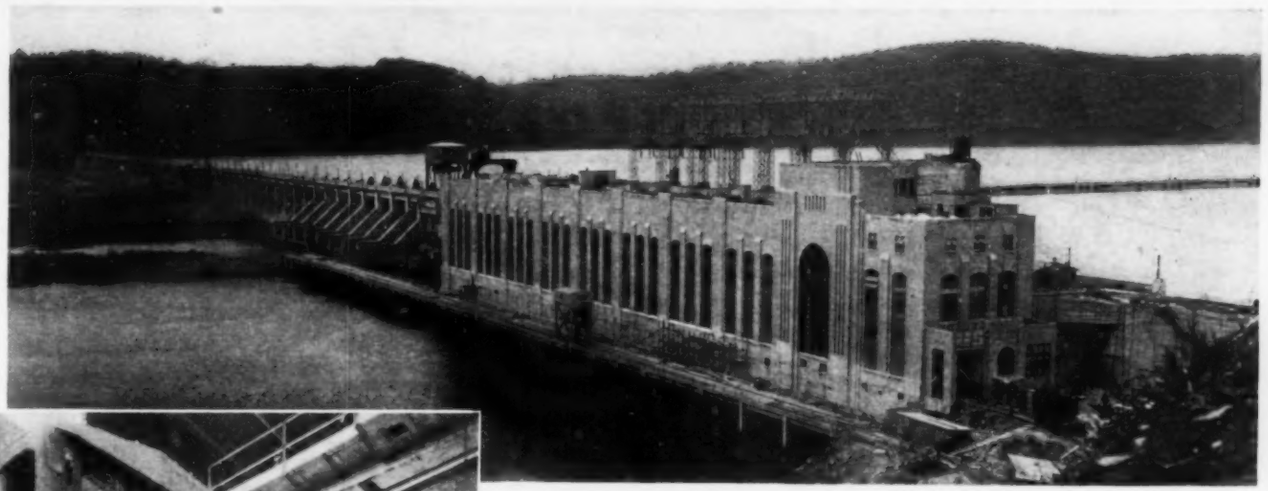
REPAIRS TO VATICAN *(below)* are under way, following collapse of a portion of the roof of the library building, which caused the death of five people. Scaffolding has been erected for replacing damaged section of ceiling.
©Wide World



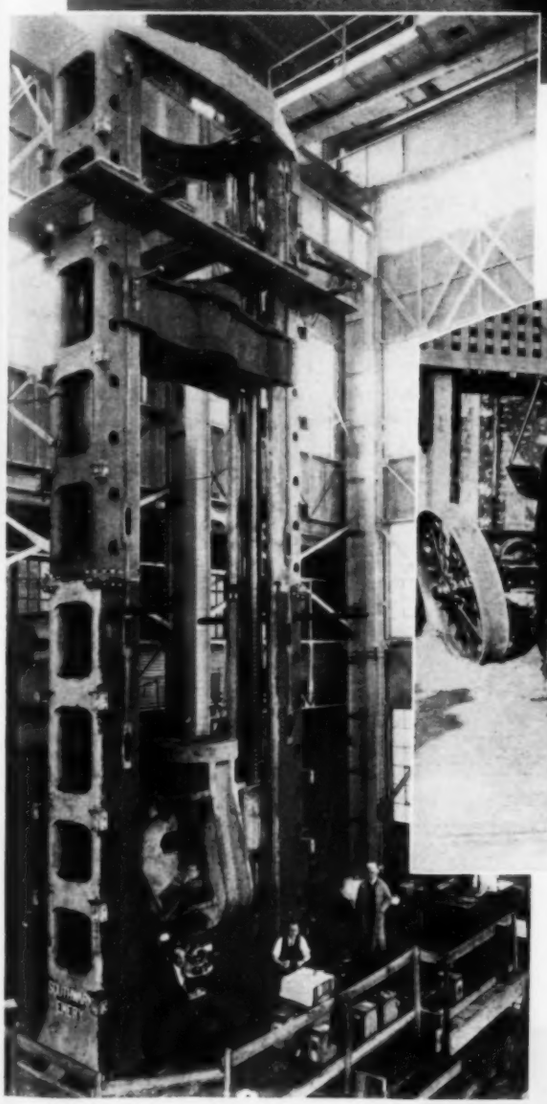
©Acme

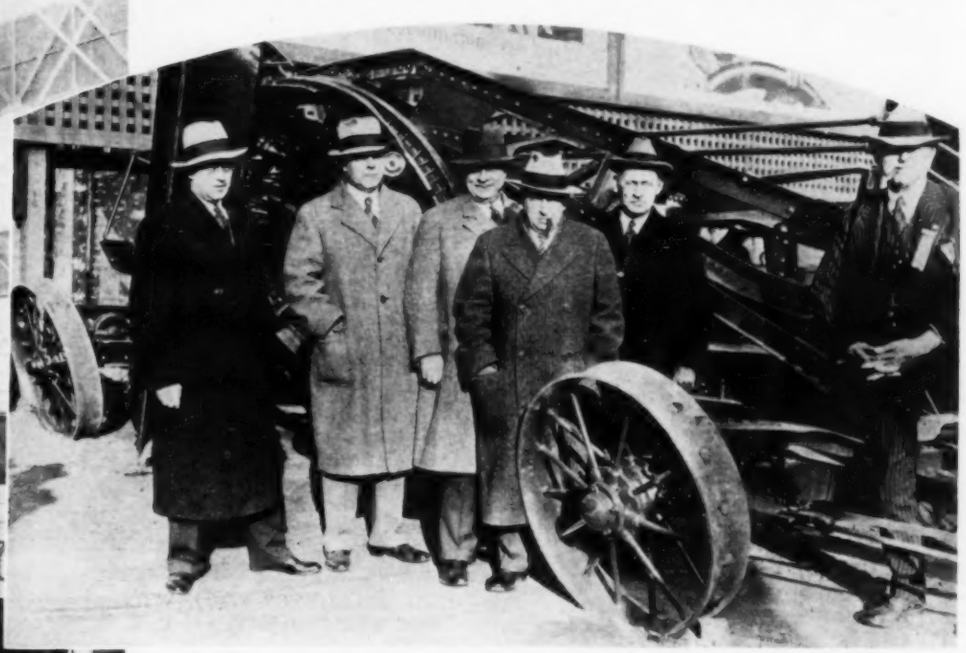
STEEL GRILLAGES are being set to support the columns of one of the several skyscraper buildings included in the development of Radio City, New York, to occupy three complete city blocks.

1931 BOARD OF DIRECTION of American Society of Civil Engineers holds final session in New York Jan. 19. Beginning at nearest corner of table and proceeding clockwise, members are: Charles A. Mead, Newark, N. J.; E. P. Lupfer, Buffalo, N. Y.; A. F. Reichmann, Chicago; F. E. Winsor (vice-pres.), Boston; H. R. Buck, Hartford, Conn.; J. F. Coleman (past-pres.), New Orleans; H. D. Mendenhall, Lakeland, Fla.; F. L. Nicholson, Norfolk, Va.; J. N. Chester (vice-pres.), Pittsburgh; Joseph Jacobs, Seattle; E. K. Morse, Pittsburgh; C. H. Stevens, Philadelphia; H. M. Waite (vice-pres.), Cincinnati; F. C. Herrmann, San Francisco; A. T. Dusenbury, New Orleans; R. C. Gowdy, Denver; Franklin Thomas, Pasadena, Calif.; Ole Singstad, New York; J. R. Slattery, New York; Miss Carolina Crook, secretary to Mr. Seabury; George T. Seabury (secretary), New York; Francis Lee Stuart (president), New York; Otis E. Hovey (treasurer), New York; C. T. Morris, Columbus; L. G. Holleran, Bronxville, N. Y. Absent: J. M. Howe, Houston, Tex.; Ralph Budd, St. Paul, Minn.; D. A. MacCrea, Little Rock, Ark.; Anson Marston, Ames, Ia.



SAFE HARBOR DAM and power house, concrete structure extending 5,000 ft. across Susquehanna River in Pennsylvania, has been completed by Arundel Corp. for Safe Harbor Water Power Corp. Initial installation for $30,000,000 project includes six 42,500-hp. turbines, totaling 255,000 hp.; ultimately twelve units will produce 510,000 hp.

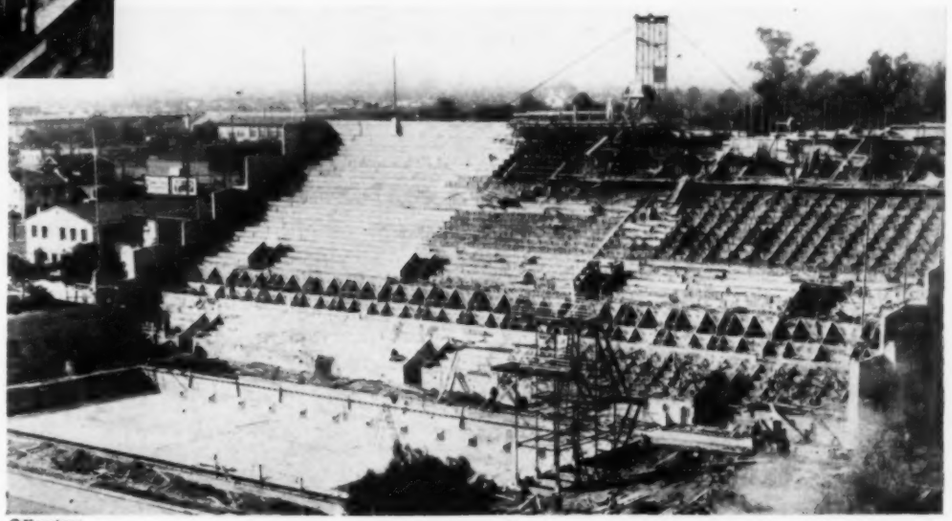




A. G. C. OFFICERS, during recent convention, visit Allis-Chalmers plant in Milwaukee under guidance of W. W. Gardner *(left)* of company's tractor division: A. E. Horst, past-president; Henry J. Kaiser, vice-president; T. J. Baker, treasurer; A. P. Greensfelder, president, 1931; W. A. Bechtel, past-president.

WORLD'S LARGEST TESTING MACHINE, built by Baldwin-Southwark Corp., Eddystone, Pa., for University of California, can apply to column 33½ ft. long loads of 4,000,000 lb. in compression and 3,000,000 lb. in tension. Principal load application is hydraulic. Machine extends 46 ft. 9 in. above and 25 ft. below floor line.

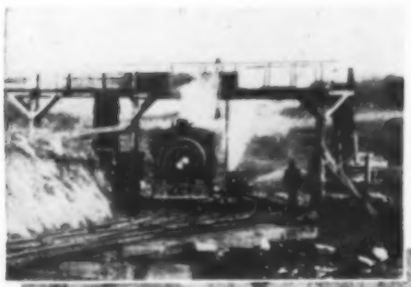
AQUATIC STADIUM *(right)*. For Olympic swimming championships this summer, concrete tank and grandstand have been constructed at Los Angeles, Calif. Structure will accommodate 10,000 spectators.



©Keystone

"Electric-Eye" Cutoff and Automatic Weight-Recording Device

Improve Concrete Control on Water-Supply Dam

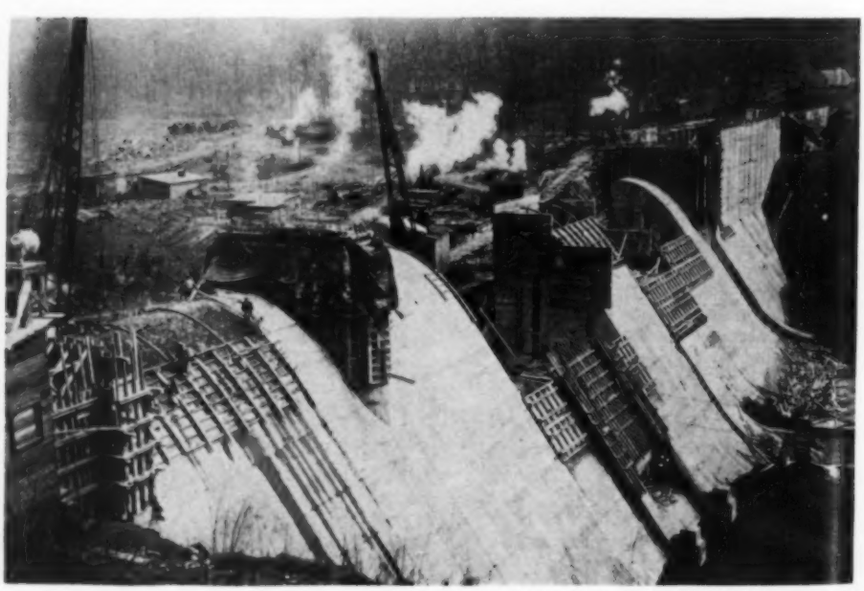


R. E. MARTIN, concrete technician; L. C. MILLHOLLAND; J. C. SHRIVER, secretary-treasurer; L. E. GOERDER, general superintendent; G. W. SMITH, superintendent (all of Vang Construction Co.); H. J. ASHCRAFT, hauling subcontractor; and F. A. BOUCHER, engineer, Vang Construction Co. COAL TIPPLE AND WATER TANK *(above)* placed at passing track on narrow-gage railway save time in refueling locomotives. Oil and sand supplies are replenished at same point.

SPECIFICATION by the J. E. Greiner Co., Baltimore, consulting engineers, of automatic feed-control and recording apparatus for weight-measurement of concrete ingredients and development by the Toledo Scale Co. of equipment to meet the engineers' requirements have largely eliminated the human factor from the control of concrete on the Thomas W. Koon dam, which the Vang Construction Co., of Cumberland, Md., and Pittsburgh, is building for the Evitts Creek Water Co., incorporated water department of the City of Cumberland. One set of scales weighs separately each of the four ingredients entering into a batch. The sand and stone are delivered to the weighing hopper by belt conveyors and cement by a screw conveyor; all three conveyors are driven by electric motors. A photo-electric cell attached to the face of the scale dial automatically cuts off these motors when the correct weights of the various solid ingredients have been delivered to the hopper. Water is weighed in a separate compartment of the same hopper, the supply being controlled by a manually-operated valve.

Directly connected with the indicat-

E. D. BILLMEYER *(left)*, WILLIAM WILLOUGHBY, and E. R. ALLEN, engineers on job for J. E. Greiner Co.

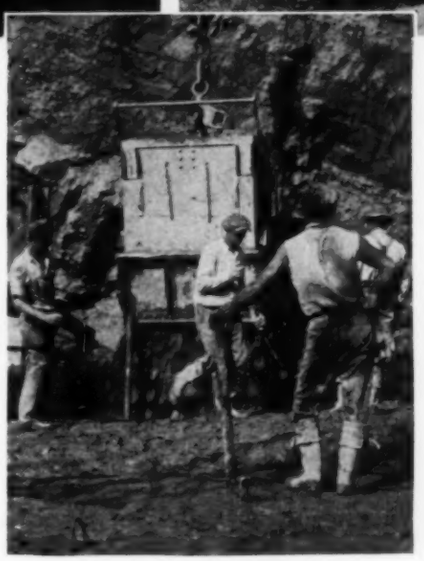


AUXILIARY WATER SUPPLY DAM *(right)* being built by city of Cumberland, Md., is concrete gravity-type structure containing approximately 68,000 yd. of concrete. Dry concrete (at left) has been placed for section of spillway crest and is being screeded to shape indicated by wood templets, without use of forms.

ELECTRIC VIBRATOR handled by three men puddles heap of dry concrete into mass homogeneous with rest of concrete.

DRY CONCRETE containing large rock aggregate is deposited in lumpy heap by 2-yd. bucket. Note templet to be used in screeding concrete to shape of spillway crest.

ing apparatus of the scale dial is an automatic recording device, the stylus of which operates visibly behind the glass of a locked door. As mounted in the scale-master's room, the stylus moves horizontally to record the weight of the concrete ingredients on a strip of graph paper traveling vertically at constant speed. The resulting curve, measured transversely with the strip of graph paper, indicates the weight of each ingredient entering into the batch and, measured longitudinally, indicates the time required for charging with each ingredient, and, indirectly, the mixing period for each batch. The graphs form a permanent and conclusive record of every concrete batch mixed on the job.

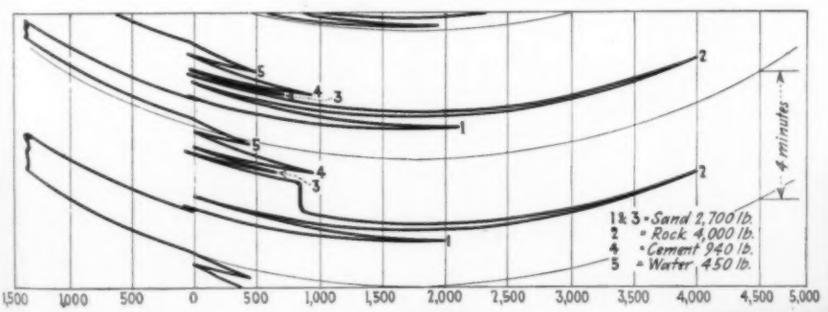


SPECIAL STRAIGHT-SIDE BUCKET deposits 2 yd. of large-aggregate concrete.

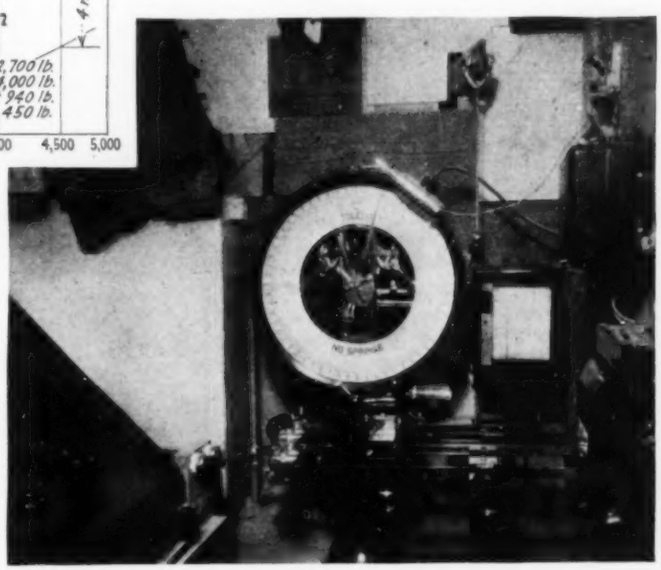
Description of Dam—The Thomas W. Koon dam is the second of two dams on Evitts Creek, in Bedford County, Pa., about 12 mi. north of Cumberland, built to develop a water supply for the city. The new dam raises the water level 67 ft.

Designed as a concrete gravity-type structure, the dam has a maximum height of 94 ft. from bedrock to spillway crest and a total length of 726 ft. Maximum thickness of the dam at the base of the gatehouse section is 127 ft., and the total length of the spillway is 240 ft. At the center of the spillway is the gatehouse structure, containing outlet control pipes. The dam carries a roadway 20 ft. above the spillway crest; this road crosses the spillway on four 60-ft. arches, two on each side of the gatehouse.

Concrete Design—Total concrete required for construction of the dam and bridge is approximately 68,000 yd. Mass concrete for the dam proper was designed with coarse aggregate 6 to 8 in. in diameter, aggregate of this size having previously been used with great success by the Aluminum Co. of America on its hydro-electric power dams. Use of large aggregate reduced the amount of mortar needed and effected a decided saving in cement. As the water-cement ratio was held at



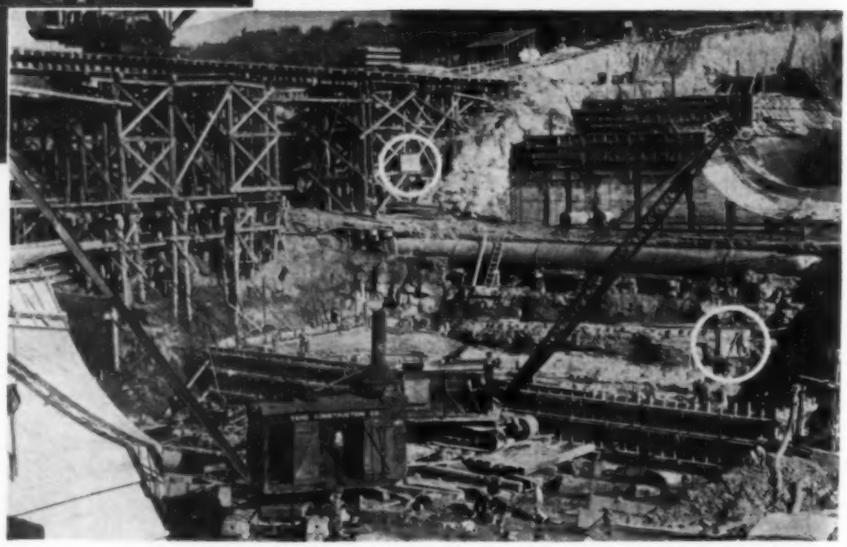
GRAPH provides permanent record of weight-measurement for each batch of concrete. Peaks of curve indicate weight of each ingredient. For reasons mentioned in article, sand is measured in two operations on this job. Peak 1 plus Peak 3 indicates 2,700 lb. of sand; Peak 2, 4,000 lb. of rock; Peak 4, 940 lb. of cement; and Peak 5, 450 lb. of water.



SCALE DIAL has photo-electric-cell attachment which cuts off motors feeding solid ingredients to weigh-hopper when indicator reaches zero. Hand on scale dial to right of indicator has paddle-shaped tip which interrupts light beam when indicator reaches zero, thus actuating electric relay which stops motor. At right of scale dial, behind small glass door, is graphical recording apparatus. At left is control desk with push buttons for starting motors.

CRUSHING, SCREENING AND MIXING PLANT *(left)*. Railway dump cars deliver quarry-run rock to primary crusher at foot of long conveyor. Arrows indicate mixer and concrete bucket on flat car.

POURING FOUNDATION CONCRETE on bedrock *(below)*. Steam whirley cranes on trestle at left and crawler cranes on bottom handle concrete buckets. Bypass pipe to carry stream flow can be seen.



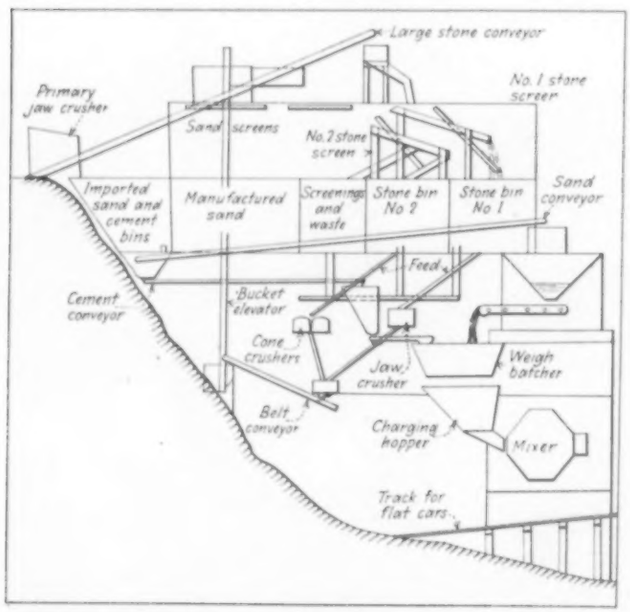
about 0.9, the resulting mix was extremely coarse and stiff. Electric-motor-driven vibrators were used to puddle the deposited concrete into a homogeneous jelly-like mass and to bring mortar to the surface.

Mass concrete placed in the dam, except in a veneer 6 ft. thick on all exposed surfaces, was designed for a compressive strength of 2,500 lb. per square inch at 28 days. Proportions of a 2-yd. batch were: cement, 750 lb.; sand, 2,800 lb.; rock, 4,000 to 4,200 lb.; and water, 450 lb., including the moisture in the sand.

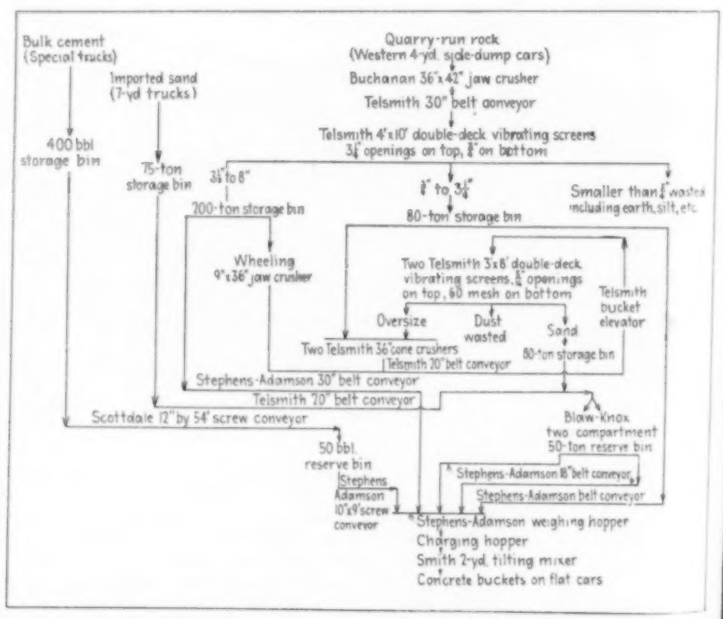
A richer mix was required by the Water and Power Resources Board of Pennsylvania for a 6-ft. depth on all exposed surfaces of the dam. This mix contained approximately 940 lb. of cement, 2,700 lb. of sand, and 4,000 lb. of rock. The water-cement ratio for this concrete was reduced to 0.8 to produce a mix that was not too soft.

Batching Control—All sand produced at the job was manufactured by crushing and screening. When concreting was proceeding at its usual pace, it was impossible to produce sufficient local sand to supply the need. Crushed and washed sand to make up the deficiency was shipped by railroad to Cumberland and hauled 12 mi. by truck to the dam.

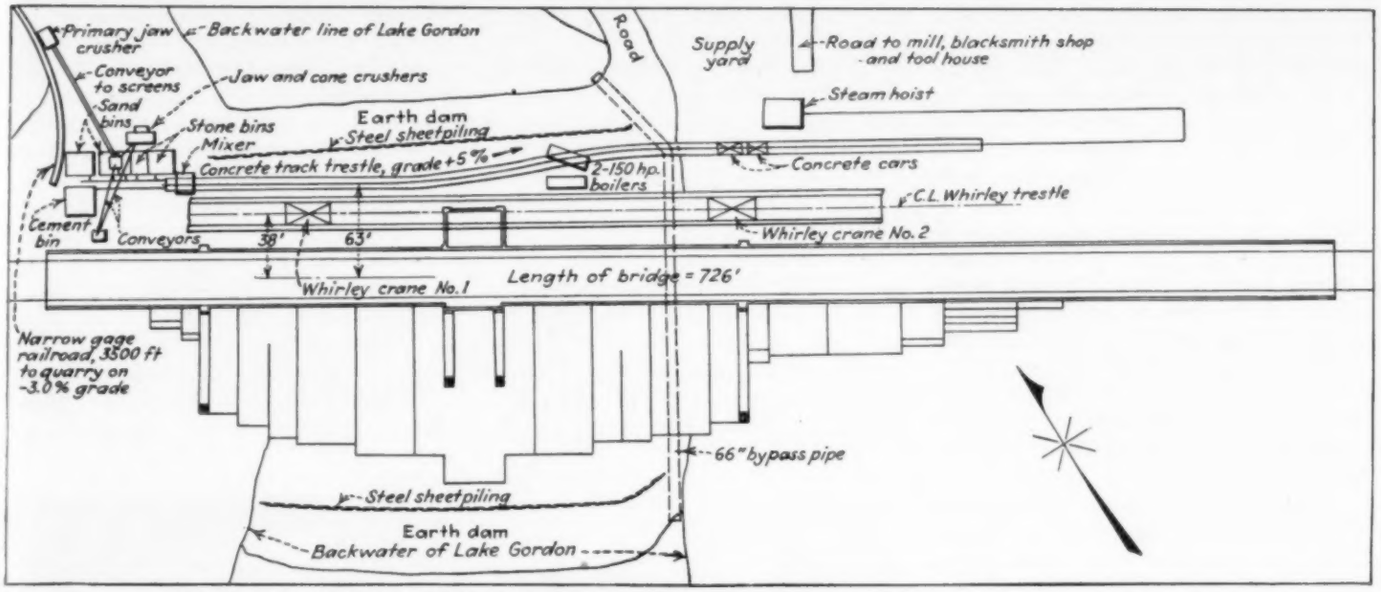
Proportions of the two kinds of sand incorporated in the mix were usually about equal, although the percentage of imported sand had to be increased when concreting was progressing rapidly, because less local rock then was available for crushing. The two sands were moved from their storage bins to a two-compartment, 50-ton reserve bin by a long 20-in. belt conveyor. It was possible to keep the manufactured sand and the imported sand separate or to mix them directly on the large transfer belt. Two shorter 18-in. belt conveyors, both driven by the same electric motor, took the sands from the two-compartment bin to the weigh hopper. The desired proportions of imported sand and manufactured sand were obtained by adjusting the gates on this bin. Large aggregate also was delivered to the weigh hopper by belt con-



SIDE ELEVATION of crushing, screening and mixing plant.


Bulk cement (Special trucks)
Imported sand (7-yd trucks)
Quarry-run rock (Western 4-yd. side-dump cars)
Buchanan 36"x42" jaw crusher
Telsmith 30" belt conveyor
Telsmith 4'x10' double-deck vibrating screens 3½" openings on top, 8" on bottom
400 bbl storage bin
75-ton storage bin
3½" to 8"
8" to 3½"
Smaller than ½" wastes including earth, silt, etc.
200-ton storage bin
80-ton storage bin
Wheeling 9"x36" jaw crusher
Two Telsmith 3'x8' double-deck vibrating screens, ½" openings on top, 40 mesh on bottom
Telsmith bucket elevator
Oversize
Dust wasted
Sand
Two Telsmith 36" cone crushers
Telsmith 20" belt conveyor
80-ton storage bin
Stephens-Adamson 30" belt conveyor
Telsmith 20" belt conveyor
Scottdale 12" by 54' screw conveyor
Blaw-Knox two compartment 50-ton reserve bin
50 bbl. reserve bin
Stephens Adamson 10"x9' screw conveyor
Stephens-Adamson 18" belt conveyor
Stephens-Adamson belt conveyor
Stephens-Adamson weighing hopper
Charging hopper
Smith 2-yd. tilting mixer
Concrete buckets on flat cars

FLOWSHEET of crushing, screening and mixing plant.



LAYOUT OF CONSTRUCTION PLANT at dam. **Reserve sand pile, diesel power house, concrete laboratory, and general offices are not shown on this plan.**

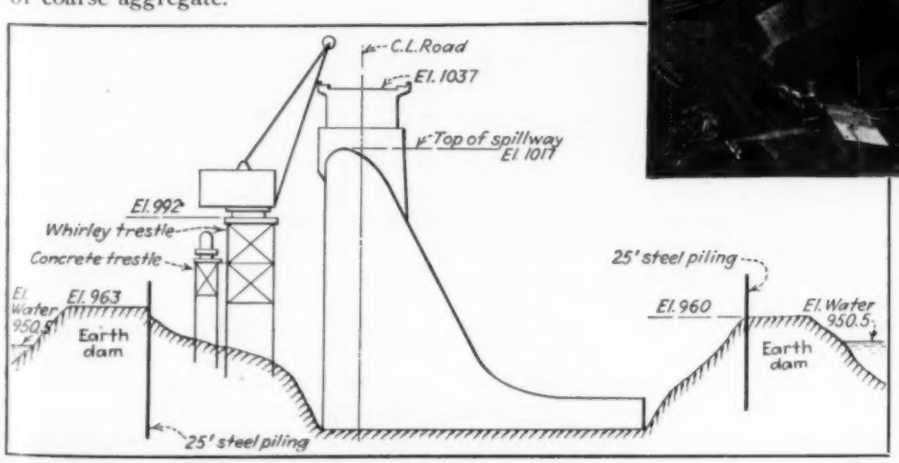
veyor; cement, by screw conveyor. All the conveyors were electric-motor-driven.

In addition to the scale dial with photo-electric-cell attachment and automatic recording graph, the batching operator's room contained a desk equipped with push-button control for the conveyor motors. The scales were equipped with three beams, each carrying two poises. Only two beams, with their four poises, were used in measuring the four ingredients of a batch.

One minor difficulty was experienced in using the equipment. The photo-electric cell cutoff worked exactly as planned in stopping the conveyor motors instantaneously. The loaded rock conveyor belt, however, because of the momentum of the material, continued to deliver aggregate to the weighing hopper for an instant after the motor stopped. It is planned on later installations of this kind to include a device for decelerating the motors as the scale reading approaches zero. On the Koon dam it was necessary to make a practical adjustment of the weighing procedure to obviate possible overweight of coarse aggregate.

Sand was measured into the weighing hopper first to provide a cushion for the rock aggregate and to prevent clogging of the discharge gate. Ordinarily, the total quantity of sand would be weighed in this first operation. To prevent possible over-weight of aggregate, as described above, however, the operator set the first poise for about 80 per cent of the weight of sand, and pushed the button to start the sand-conveyor motor. As the pointer on the scale dial reached zero, the photo-electric-cell mechanism shut off the motor. The operator then set the second poise for the weight of rock aggregate, and the cutoff functioned as before. After the rock was in the weighing hopper, the operator moved the sand poise to its final position, and exactly enough sand was delivered to the hopper to make up the correct total weight of combined aggregates. Cement was then weighed in the normal way.

As the last step, water was weighed into a separate compartment of the same hopper. In the original plant,



TWO STEAM WHIRLEY CRANES *(above)* **on construction trestle along upstream face of dam handle concrete buckets from flat cars on adjoining trestle. Concrete cars are pulled up their runway by hoist-operated hauling rope and are returned to mixing plant by gravity. SECTION OF DAM through spillway** *(left)* **showing construction trestles along upstream face and earth cofferdams having steel sheet-pile corewalls.**

although not required by the specifications, water was delivered through a motor-operated valve, this motor being controlled as were the others, by a push button to open the valve and the photo-electric-cell cutoff to close it. The valve, however, proved too small, unduly prolonging the discharge of water into the hopper. A larger valve was substituted; this valve was quickly closed by the operator's foot as he watched the pointer on the scale dial approaching zero. On future installations, solenoid valves will be used in conjunction with the electric eye. Total time required for weighing the four ingredients of a 2-yd. batch was less than 2 min.

Concrete Placing—All concrete was transported and deposited by bucket. Mass concrete was handled in special straight-side bottom-dump buckets of 2-yd. capacity. These buckets were charged on standard-gage flat cars underneath the mixer and were pulled up a 5 per cent grade on a timber trestle, constructed parallel with the dam, by a hoist-operated hauling rope. The concrete runway was about 500 ft. long. Between the runway and the dam was a level timber trestle 300 ft. long at an elevation 25 ft. below the spillway crest. This trestle carried an 11-ft. 2 in. gage track on which operated two Dayton-Wiley whirleys, with 75-ft. booms. The whirleys handled the concrete buckets from the flat cars to all parts of the dam within their reach. Koehring gasoline cranes with booms 50 ft. in length, operating on the ground and on the dam itself, handled concrete to those parts of the structure which were inaccessible to the whirleys. Rehandling of the concrete bucket from machine to machine was necessary in some places, particularly on the east abutment, the maximum amount of handling being a pass from a whirley to one crane to a second crane. Concrete for the thinner sections of the superstructure was placed from 1-yd. bottom-dump buckets with sloping sides.

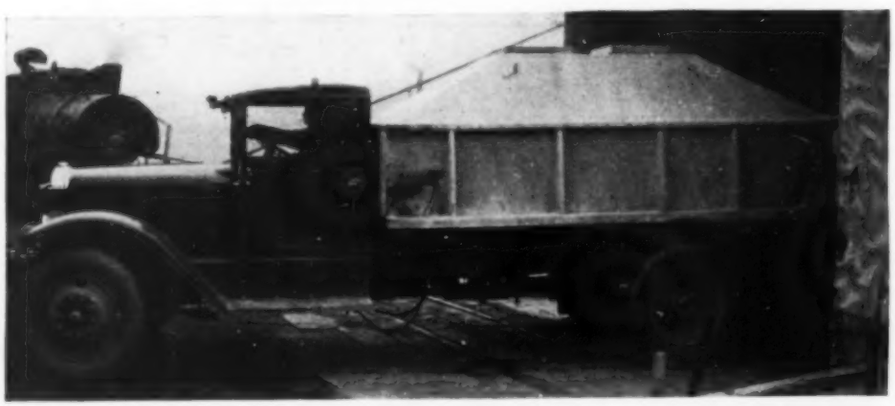
Large-aggregate concrete was deposited by lowering the bucket close to the surface of the concrete, opening the gates, and slowly raising the bucket. This method of depositing the material prevented separation and left the discharged mass in a heap, with the large rock protruding from the surface. To work this heap into a homogeneous, pulpy mass, the contractor used mechanical vibrators of the Electric Tamper & Equipment Co., each vibrator being operated by three men. The vibrators puddled the jagged heap into a level mass, homogeneous with the rest of the concrete and possessed of a mortar surface. High-strength concrete for the thinner sections was vibrated in the forms by smaller electric machines clamped to the outside of the formwork.

Sectional wood forms for all concrete work were made in a yard on the job. Panels for the main dam structure were 16½ ft. long by 8 ft. deep, concrete being placed in sections 33 ft. long by 8 ft. high, except on the abutment portions, where the sections were 40 ft. or 25 ft. long, depending upon the distance between expansion joints.

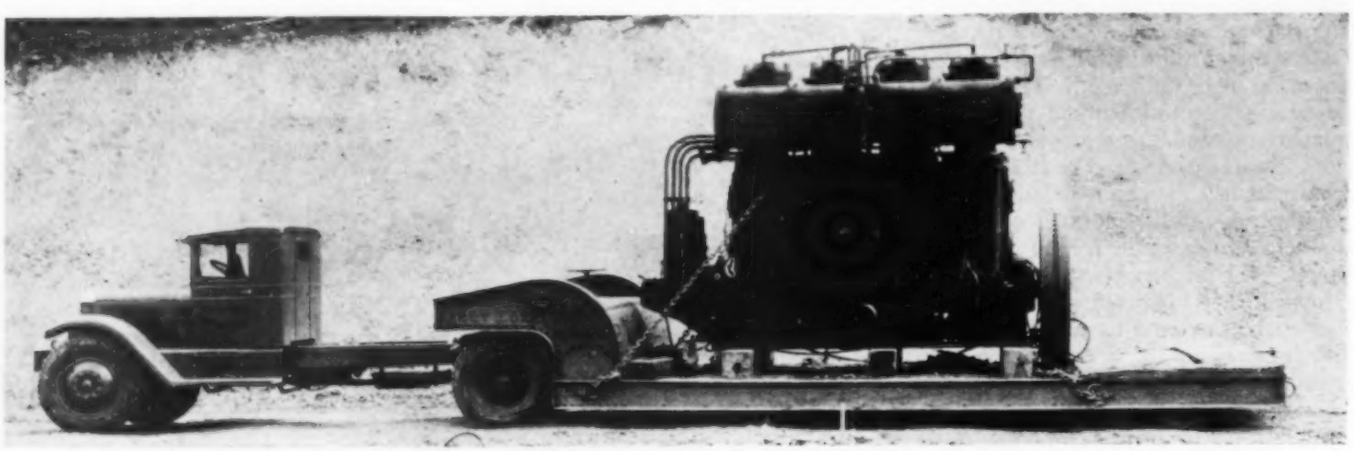
Panel forms for the dam were erected in the usual way by fastening the forms with Universal clamps to rods protruding from the exposed surface of the dam and by tying the panels with wire secured to steel anchorages buried in the top of the previous lift. Richmond Tyscru form ties were used in bracing the forms for the columns and walls of the superstructure.

Starting Job—The dam site was inaccessible by railroad or highway, and was too far from a transmission line to make purchase of electric power economical. It was planned to drive the machinery of the crushing and screening plant by electric motors supplied with power by a job plant. The first need of the contractor was to build 1,400 ft. of road on the west side of the dam, connecting with a former township road which has lately been taken into the state highway system. Construction of this stretch of road required a cut 60 ft. deep and total excavation of 44,000 yd., 15,000 yd. of which was rock.

Trucks and trailers transported all construction plant and equipment 12 mi. from the railroad at Cumberland. The heaviest piece of machinery was a 300-hp. diesel engine, weighing 40 tons.



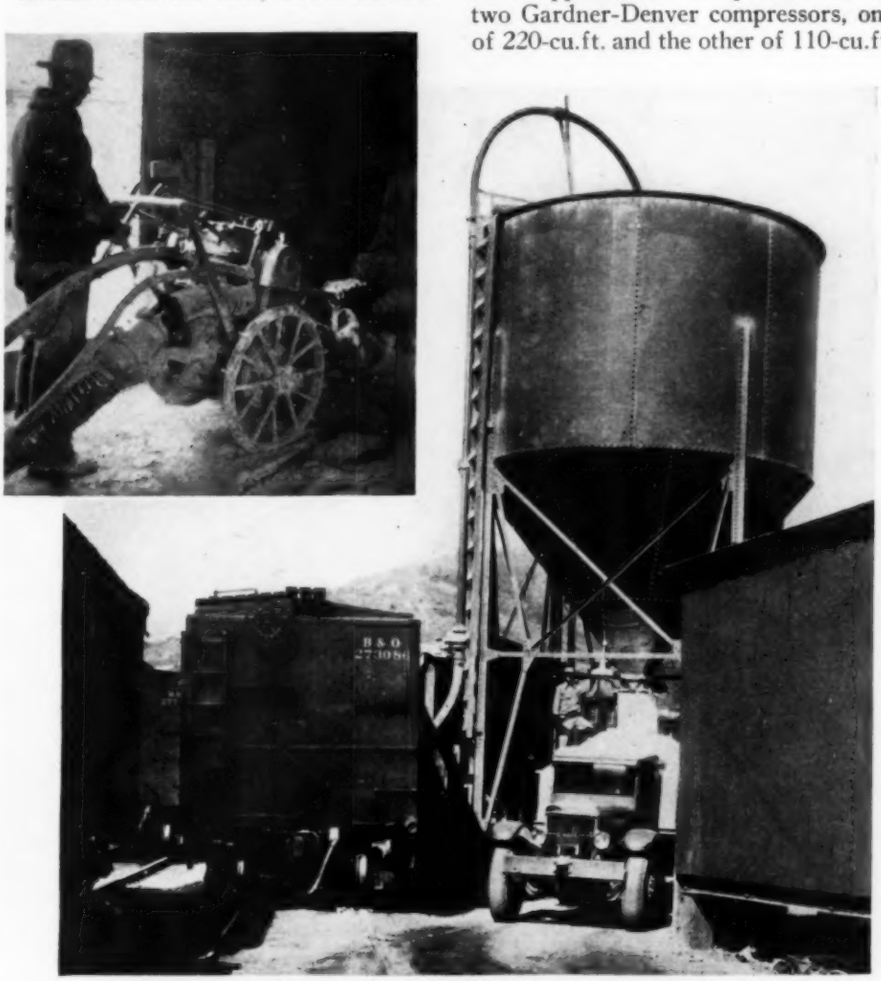
SPECIAL CONCRETE TRUCK, with covered steel body having two doors on top, dumps load into cement bin at mixing plant.



300-HP. DIESEL ENGINE, weighing 40 tons, is transported 12 mi. to job by truck and trailer.

for the electric-power plant. This plant also contained a 150-hp. oil engine.

Quarry—It had originally been intended to open a quarry in the hillside adjacent to the highway cut at the dam. Excavation of the cut, however, showed that the supply of rock at this point was insufficient. Footings and piers for the crushing and screening plant on the steep hillside at the dam already had been poured, just below the site of the proposed quarry, and erection of the plant at this location was carried forward without any change of plan. Jagged bluffs of hard calcareous sandstone rising to a maximum height of 124 ft. were found 3,500 ft. upstream from the dam, and a narrow-gage railroad was constructed on a 3 per cent upgrade from this site to the crushing plant.



200-TON STEEL BIN, filled with cement by compressed-air unloading system, charges special-body cement truck by gravity. ELECTRIC-MOTOR-DRIVEN UNIT *(above)* unloads cement cars. Horizontal revolving disk and short screw conveyor deliver cement to air line.

Crushing and Screening Plant—Three Porter steam dinkeys hauled trains of eight loaded cars up the 3,500 ft. of 3 per cent grade from the quarry to the crushing plant. The accompanying flowsheet of the crushing, screening and mixing plant indicates the processes and equipment through which the quarry rock and other raw materials passed in being manufactured into concrete. Switches controlling the electric motors which drove all the mechanical equipment of the crushing and screening plant were located in a central control room. Signals to start and stop the various motors were given to the control operator by means of electric lamps, a lamp being mounted above each switch. Push buttons close to each piece of equipment were used by workmen about the plant to signal the operator.

Cement Handling—Bulk cement was unloaded from railroad cars on a siding at Cumberland by a manually-operated electric - motor - driven Fuller - Kinyon unit supplied with compressed air by two Gardner-Denver compressors, one of 220-cu.ft. and the other of 110-cu.ft. capacity. The feeder unit of the Fuller-Kinyon conveying system was equipped with a horizontal revolving disk which cast the cement into a screw conveyor delivering to a compressed air connection. The air picked up the cement and carried it through a hose and a vertical pipe rising about 35 ft. into the top of a Heltzel 200-ton steel bin. Cement unloading proceeded at a rate conservatively estimated as 150 bbl. an hour.

Two motor trucks equipped with special bodies having two doors on the top, as illustrated by one of the photographs, were loaded by gravity under the cement bins. At the mixing plant, the trucks end-dumped their loads into a 400-bbl. storage bin.

Stream Control—The dam site was protected from flooding by an upstream and a downstream earth cofferdam, each of which had a Lackawanna steel sheet-pile core. These cofferdams were built out progressively from the east side of the valley as foundation operations advanced. Before extending them the full distance across the valley, the contractor installed a 66-in. steel-plate bypass pipe through the dam. This pipe could take care of a flood of 250,000,000 gal. a day. The maximum recorded fall flood amounted to 500,000,000 gal. a day; but a pipe of the stated capacity was ample to provide for any flood within the limits of probability. Upon completion of the dam, the pipe was filled with concrete and grouted.

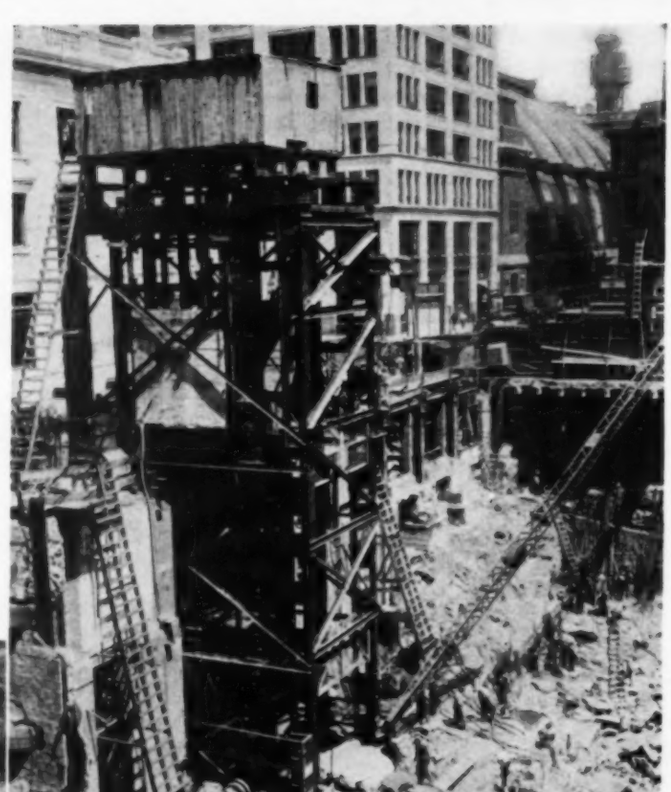
Foundation Excavation—Excavation for the foundation amounted to approximately 30,000 yd. of earth and 30,000 yd. of rock. Most of this material was dug by power shovels and by whirley or crawler cranes, operating clamshell buckets and was loaded into Linn tractor-trucks, Athey crawler wagons drawn by Caterpillar tractors, and trucks. The rock was drilled by Ingersoll-Rand and Gardner-Denver jackhammers operated by portable compressors. Final cleaning of the foundation rock was performed by hand labor, the rock being loaded into skips which were handled by the whirley cranes.

Progress—As already stated, the first shovel moved in to start the highway grading on the west approach to the dam, June 4, 1931. The first concrete was placed September 14. Average concreting progress was 18,000 to 19,000 yd. a month. The best day's run was on Sunday, Dec. 27, when the output for the first 12-hr. shift at the mixing plant was 546 yd., or 284 batches, and the total for the two 12-hr. shifts was 881 yd., or 474 batches. Concrete-placing crews worked on 8-hr. shifts.

Direction—In charge of operations at the dam for the Vang Construction Co. are L. E. Goerder, general superintendent; G. W. Smith, superintendent; F. A. Boucher, field engineer; and R. E. Martin, concrete technician. William Willoughby, resident engineer, supervises the work for the J. E. Greiner Co. For the City of Cumberland, Ralph L. Rizer is city engineer, and C. J. Bruce is superintendent for the water company.

Shovels Load Trucks at Bottom of 70-FT. HOLE

Dust Collectors for Rock Drills Prove Value in Experimental Test



ELECTRIC ELEVATOR with counterweighted platform raises loaded trucks 38 ft. to street level. Power shovels also are taken up before elevator is dismantled.

HOIST-OPERATED HAULING ROPE, hooked to rear of truck body, assists loaded truck up steep ramp to elevator. In background are benching operations by drillers and shovels loading trucks on bottom.

LOADED TRUCK drives from elevator platform on to street. Electric hoist in house atop tower operates elevator.

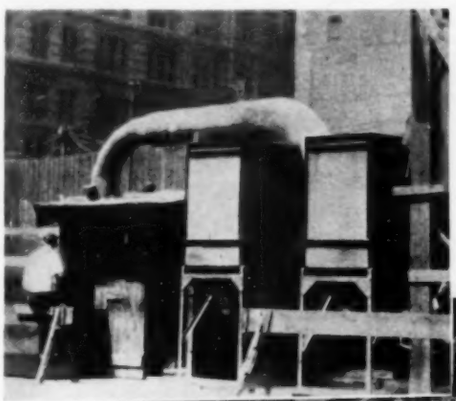
A LARGE rock excavation job to a depth of 70 ft. below street level for the first unit of the Metropolitan Life Insurance Co.'s home-office group of buildings in New York City was distinguished both by the advanced methods of the contractor, Starrett Bros. & Eken, Inc., in removing spoil and by the initial field test of experimental equipment to eliminate the dust evil in drilling. By the use of an electric elevator to a depth 38 ft. below street level and a steep ramp equipped with a booster hoist leading to this elevator, the contractor was able to load trucks on the bottom of the excavation. In addition, the job involved interesting methods of shoring the earth banks along two streets and of underpinning and protecting two buildings adjoining the excavation.

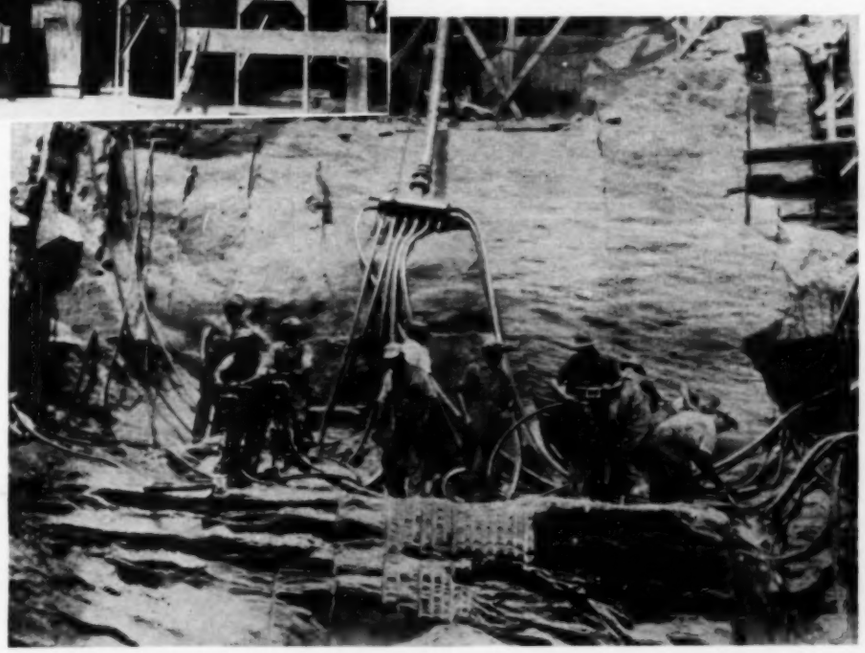
Extent of Job—The building has 28 stories above street level and four floors below; it occupies one end of the block between 24th and 25th Sts., fronting 197 ft. 6 in. on 4th Ave. and 200 ft. on each of the side streets. Excavation between building lines involved 24,500 yd. of earth and 52,500 yd. of rock. Sidewalk vaults required additional excavation amounting to 6,000 yd. of earth and 8,100 yd. of rock. Difficulties of excavation were increased by the proximity of the 4th Ave. subway line, which passes within 23 ft. of the building line and within 8 ft. 6 in. of old vaults under the 4th Ave. sidewalk.

Earth cover on the foundation rock averages about 22 ft. deep. The site was occupied by buildings which had to be wrecked before excavation could begin. Operations were retarded by delay in vacating one of these buildings, at the corner of 4th Ave. and 25th St. This building was equipped with

sidewalk vaults having massive longitudinal and transverse masonry walls, extending to rock, which served to support the earth banks and the pavement for approximately 100 ft. on 4th Ave. For the remaining 100 ft. on 4th Ave., the contractor constructed a rubble-masonry wall 4 ft. 6 in. thick, built up in alternate sections in sheeted pits outside the building line.

For the full frontage on 24th and 25th Sts., the contractor adopted a method of shoring which practically eliminated timbering and bracing within the limits of the excavation.





DUST ELIMINATORS around drills are connected by 2-in. hoses to manifold. Slight vacuum in collector at drill produces air seal, reducing dust count to safe limit in air breathed by operator. CENTRAL GATHERING UNIT *(above)* of experimental dust collecting system induces draft in feeder lines and removes dust from incoming air. Two rectangular tanks contain dust collectors.

Walls of steel sheet piling were driven to rock on the curb line 15 ft. beyond the building line, and concrete buttresses resting on rock were poured at about 25-ft. centers to support the sheeting. In this way the hole itself was kept clear for the operation of shovels and trucks. After steel erection had risen above street level, the sheet-pile walls on the two sides of the building were braced by timber struts against the structural frame, permitting the buttresses to be demolished and the rock excavated to make way for sidewalk vaults.

Elevator — Practically all spoil in the excavation was loaded directly into trucks by power shovels operating on the bottom. Until excavation had reached a point about 30 ft. below street level the trucks hauled their loads up a ramp, with the aid of a booster hoist operating a hauling rope. At this point an electric counterweighted platform hoist running in a steel tower was installed in a pit on the 25th St. side to a depth 38 ft. below street level. The elevator had been designed by W. T. MacIntosh, of Spencer, White & Prentis, Inc., for operation on the Abraham & Straus building, in Brooklyn, and had been used on that job. A Lidgerwood hoist, driven by a G.E. 100-hp. electric motor, was mounted on the top of the structural steel tower. The capacity of the elevator was 35 tons, sufficient to take up the shovels without their booms at the end of the job. A safety device under the platform was designed to prevent the elevator from dropping more than 6 in. in case of a failure of any part of the equipment. Eight dogs were so hung that they would dig into the 12x12-in. timber elevator guides and thus stop the descent of the platform.

As excavation proceeded below the base of the elevator, a timber ramp was constructed for the trucks. By the time excavation had reached final grade, this ramp was on a 23 per cent grade. A Lambert hoist driven by a 65-hp. Westinghouse electric motor helped to pull the trucks up this slope.

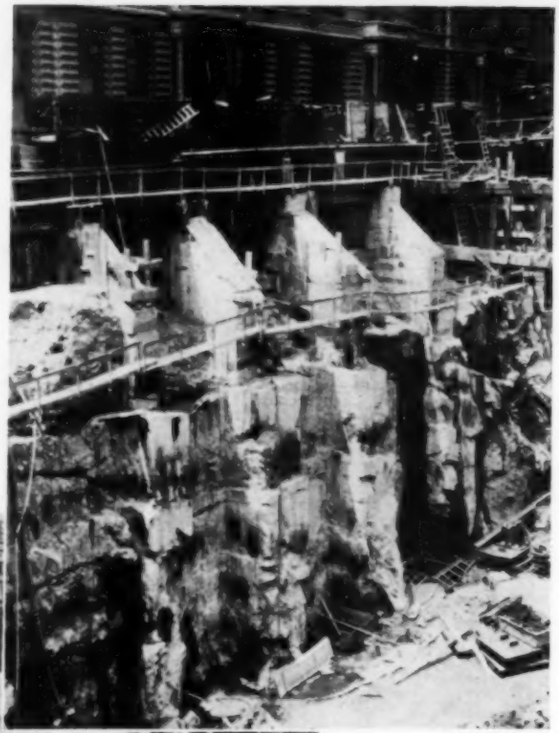
Chicago Booms—As the Metropolitan Life Insurance Co. owned all the buildings in the block, the contractor was permitted to erect Chicago booms on two outside steel columns of the buildings adjacent to the excavation. Both of these booms, one 100 ft. and the other 110 ft. in length, were operated by 100-hp. Thomas electric hoists. At the start of the job, the contractor had two stiff-leg derricks erected in the conventional manner on steel I-beam cross-members at corners of the excavation. Later on, a 110-ft. steel Chicago boom, operated by a Lidgerwood 65-hp. electric hoist, was installed on one of the columns of the elevator tower, dispensing with the need for one of the stiff-leg derricks. The remaining stiff-leg derrick, with 90-ft. timber boom, was operated by a Lidgerwood 65-hp. electric hoist having two drums and a swinging engine.

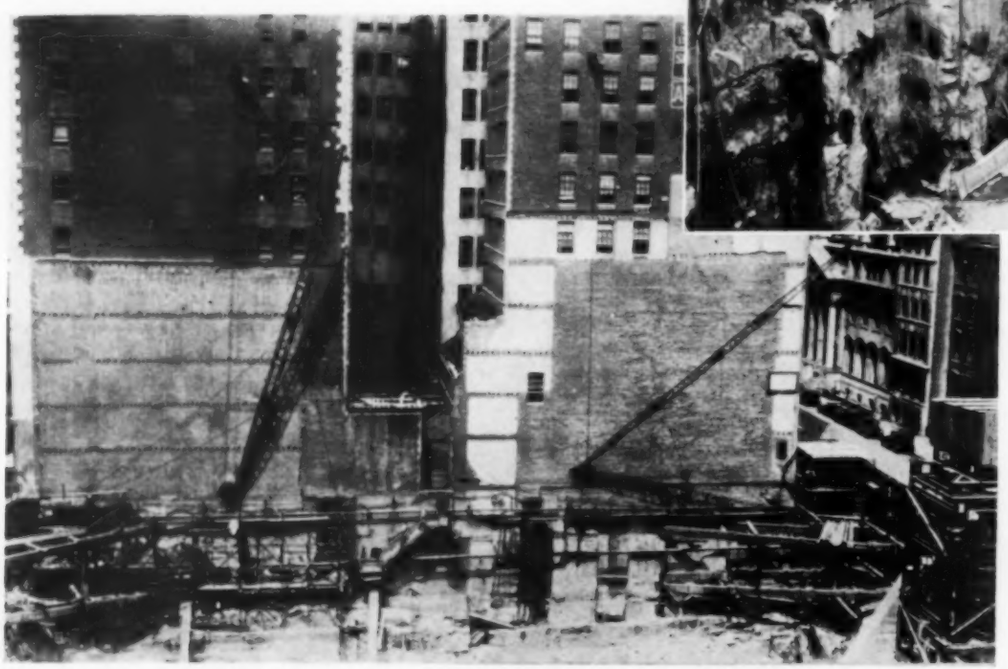
Dust Collectors—The foundation rock was hard Manhattan schist, a formation containing in places up to 84 per cent silica, dust of which often causes silicosis in drill runners. With the assistance of the Metropolitan Life Insurance Co., which supplied the funds for the experiment, and of several associated institutions, such as the New York State Department of Labor and the Harvard School of Public Health, a test was made on the job of equipment designed by George F. Kelley, master mechanic of the George J. Atwell Foundation Corp., to remove

DUST COLLECTOR at drill consists of steel-plate cap in two hinged parts with circular hole in top which fits loosely around steel.

IN CHARGE for Starrett Bros. & Eken, Inc.: E. T. PETERSON *(left)*, resident engineer; WILLIAM HARGRAVE, field superintendent; and DAVID STIRRETT, superintendent.

CONCRETE BUTTRESSES *(right)* on rock support steel sheet-pile wall. Buttresses are spaced to allow excavation for outside column footings, forms for which are being placed. Later on, steel sheeting will be braced to structural frame of building, and buttresses and rock will be removed.





CHICAGO BOOMS *(left)* on outside columns of buildings next to excavation eliminate need for stiff-leg derricks. Footings of buildings have been underpinned to rock.

the dust hazard from drilling operations. Although this first installation was merely experimental, it proved so successful that it has encouraged developments which may result in dust-collecting apparatus applicable to all types of drilling jobs. The system employed on the Metropolitan Life foundation collected 8 tons of dust per day from 60 Ingersoll-Rand jackhamer drills operated on the job, and, according to test results, reduced beyond the dangerous limit not only the visible dust but also the invisible particles which are the most serious cause of silicosis.

The equipment consisted essentially of an induced-draft system leading to a central dust-collecting plant. A cap to gather the dust was placed around the drill steel over each hole, as illustrated by one of the photographs, and was connected by a 2-in. rubber hose to a manifold equipped with intakes for ten drills. Each manifold was connected by a 6-in. hose to a 10-in. header pipe which extended from the central plant to all sides of the excavation.

Drilling and blasting were carried on by the benching method, down holes only being drilled. The maximum charge of explosive permitted by New York City ordinance was 32 sticks of duPont 40 per cent gelatin dynamite. Wire-rope mats 10x12 ft. in size, weighing approximately 2,000 lb. each, were placed over the blasts to prevent scattering of rock. The initial blasts reduced practically all the rock to a size for loading by three Thew Lorain $1\frac{1}{4}$-yd. and one Mead-Morrison $\frac{5}{8}$-yd. gasoline crawler shovels.

Protecting Existing Buildings—Outside footings of the two buildings adjoining the site were exposed by the excavation and were underpinned to solid rock. One of these two structures, the Slattery Building on 25th St., was only 75 ft. wide. To prevent any damage to this building in case of disturbance to the footings, the structural frame was tied to the frame of the 25 Madison Ave. building, adjoining it on the side opposite the excavation. A line of 24-in. 70-lb. I-beams was placed behind the columns of the Slattery building at the 7th floor level. These I-beams were tied to five columns on the 25 Madison Ave. building with four $1\frac{1}{8}$-in. tierods at each column.

Excavation had to be extended under five outside columns of the second building adjoining the site, the old Metropolitan Annex. The grillage under each of these columns now rests on a pair of needle girders 7 ft. deep, supported at one end by a footing below the basement of the Annex and at the other end by a 40-ft. column extending to a footing at the general level of excavation for the new building.

Supervision—For Starrett Bros. & Eken, Inc., general contractor, David Stirrett is superintendent, William Hargrave, field superintendent, E. T. Peterson, resident engineer, and George Hoffmire, job manager.

No Post Hole Digging With This

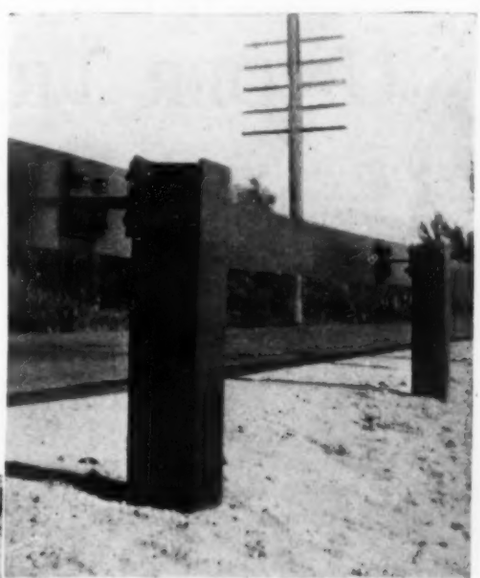
ALL-STEEL HIGHWAY GUARD RAIL

WITHOUT the necessity of digging the usual post holes, a highway guard rail installation has been made at Acton, Mass., by the New England Structural Co., of Boston, employing a new type of all-steel construction designed by the American Institute of Steel Construction. Posts, supporting a horizontal steel plate band 8 in. wide, are 6-in. H-columns driven into the ground by a light, portable pile driver. Connections are bolted.

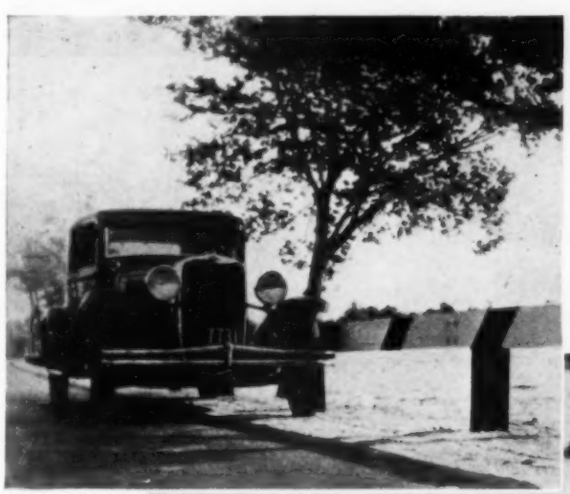
Among advantages claimed for the all-steel road guard are that it is strong, durable, conspicuous in appearance, and designed to deflect back on to the roadway, without overturning, motor vehicles that strike it.

Where there is no embankment the steel posts are driven vertically, but on embankments where there is not sufficient earth to hold vertical posts, they can be driven toed in at an angle to insure ample earth resistance. With both vertical and inclined posts, the steel plate guard is offset from the posts by means of brackets bolted to the flanges, as shown in one of the illustrations. This feature prevents the wheels or body of a car from striking the posts. Extra holes punched in the post flanges provide for vertical adjustment. Horizontal adjustment is made by using shims of wood or steel. The horizontal steel guard plates are 8 in. wide and $\frac{1}{4}$ or $\frac{3}{16}$ in. thick. At one end $\frac{13}{16}$-in. holes provide for $\frac{3}{4}$-in. bolts, while at the other are $1\frac{1}{4}$- or $1\frac{1}{2}$-in. slotted holes. These provisions for adjustment are ample to compensate for slight inaccuracies in driving the posts. The horizontal guard plate is placed high enough above the center of gravity of the ordinary automobile to prevent the car from overturning.

Both plates and brackets are designed for the strength and flexibility necessary to meet service conditions without serious injury to the posts. When plates or brackets are bent in service, they can be cold-straightened or replaced by new parts on the original posts. With bolts drawn up tightly, the flexibility of the plate and friction between plates at the slotted holes take up sharp impact stresses.

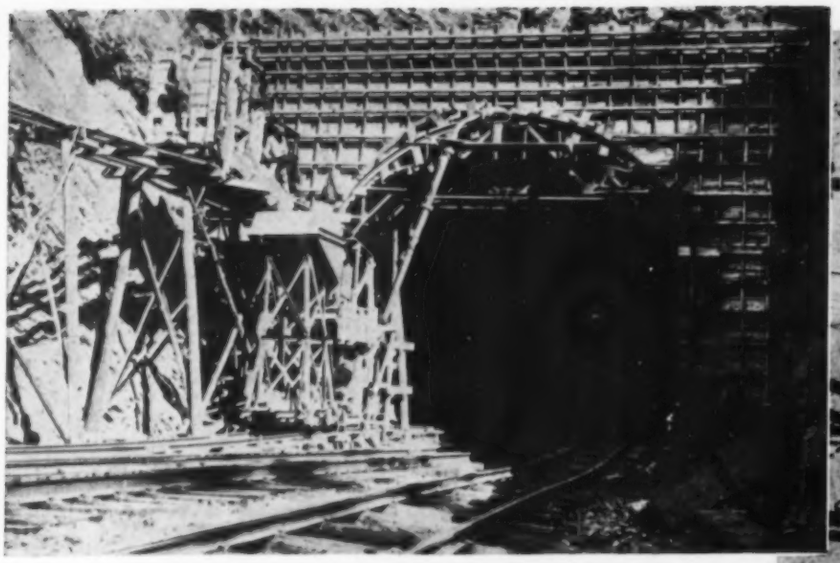


HEIGHT OF RAIL *(left)* **prevents car from overturning when it runs off road.**

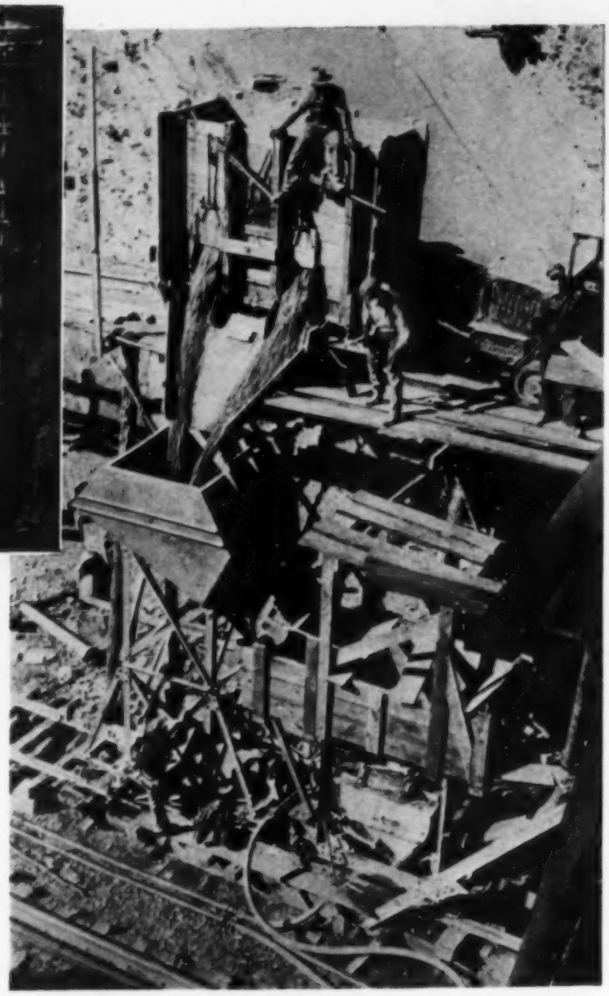


BRACKETS *(right)* **hold steel guard out from H-column posts. Connections are made with bolts.**

STRIPED PAINTING *(below)* **on roadside face of steel guard makes it conspicuous guide to traffic.**



PLACING CONCRETE in portal forms with pneumatic outfit mounted on narrow-gage car. Hopper car on light trestle at left transports concrete from mixing plant to portable placing outfit.



HOPPER CAR on trestle delivers to supply bin on portable pneumatic placing outfit.

Double-Track Tunnels ENLARGED UNDER TRAFFIC

Second of a series of articles on mainline tunnel improvements by the Chesapeake & Ohio Railway

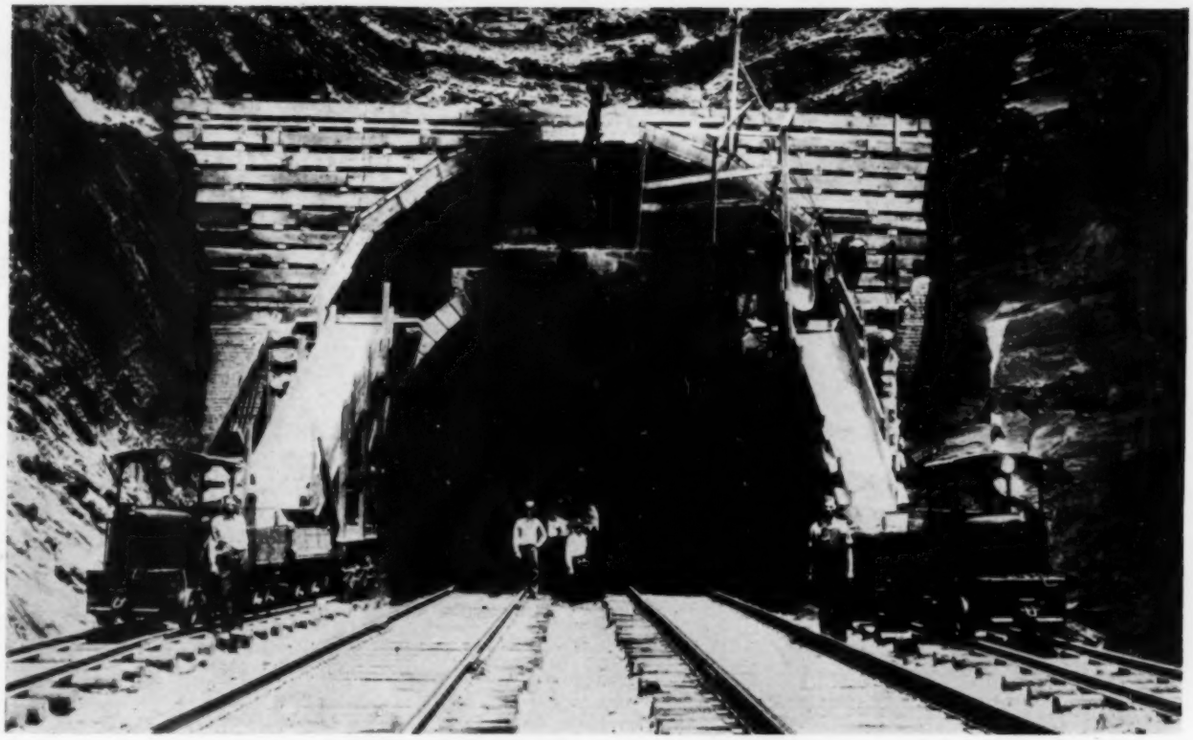
AMONG the difficult tunnel jobs included in the extensive betterment program of the Chesapeake & Ohio Railway Co. through the Alleghany Mountains in Virginia and West Virginia is the enlargement of three short adjacent double-track tunnels just east of the summit of the range. One of these, a 727-ft. bore known as the Lakes tunnel, has been increased in size in a manner more or less similar to that used in the other two.

When the improvement work started, Lakes tunnel carried two main-line running tracks, with side clearances of 7 ft. from the center line of the tracks, which were on 12-ft. centers. Overhead clearance was 14 ft. 6 in. above the top of the rail at a point 5 ft. out from the center line of the track. After the enlargement is finished, the new concrete-lined section will provide clearances of 9 ft. from the center line of the tracks, with the latter on 14-ft. centers. The new overhead clearance will be 22 ft. above the top of the rail at a point 5 ft. from the center line of the track.

In order to construct this much increased section the old cut-stone portals and the old brick-masonry lining had to be completely removed and the seamy shale through which the tunnel was driven had to be excavated to the new dimensions. All of these operations had to be handled over and around traffic on the main-line tracks. The number of train movements not only is large, but also includes many long eastbound loaded coal trains, with even longer westbound trains of empties. Construction methods had to be worked out under these constant handicaps of lack of space, moving trains and exceptionally bad ground.

As the first step, the cover over the old portals was removed back far enough to permit the portals to be taken out and a heading turned under at both ends. Both headings were of the full section required to bring the excavation

(Left to right) F. C. CUNNINGHAM, senior inspector, J. A. COOKE, resident engineer, and D. W. FRASER, superintendent for Sturm & Dillard Co.



CHUTES at portal deliver spoil from enlargement work in first stages of job.

to the dimensions of the new tunnel above the springing lines of the arch.

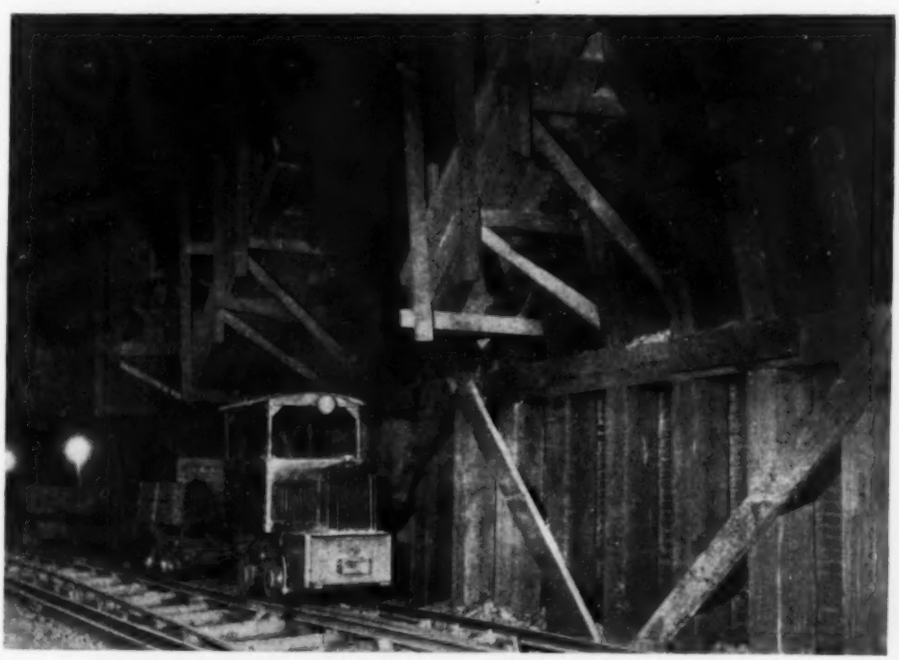
In the beginning the plan was to proceed in this manner until the excavation over the old brick arch had been carried far enough ahead to permit the removal of the lining to be started, working from both ends. After the heading from the east portal had been advanced 50 ft., however, the crew in that heading unexpectedly broke through into a cavity over the old brick lining. This overhead cavity was roughly 125 ft. long, and extended almost the width of the tunnel, with a space as much as 7 ft. in height above the top of the old brick arch. While no records were available, it appears that this space had been packed with timber when the arch was built. At any rate, only a thin layer of pulp was left over the surface of the arch when the cavity was entered. The exposed shale formation slakes quickly in the air. During all the years it had been sealed completely by the masonry it had stood well, but, open to the air, it became a menace to the heavy traffic on the main-line tracks below.

To meet this entirely unforeseen situation the main-line tracks were gauntleted through the tunnel. This permitted heavy timbering to be placed inside the old brick lining to support the latter. Then the soft shale roof of the cavity above was shored up on the old brick arch until the headings could be advanced and timbered.

Even with this support all operations had to be handled carefully to avoid cave-ins. Drifts for the wall plates of the timbering of the headings were pushed ahead on both sides far enough to set a 16-ft. plate on each side at a time. With a pair of plates set, the core of the heading over the old brick arch was removed. Timber arch rings were set just as fast as space for them could be obtained by taking out the core material. This meant that all of the shooting had to be done in numerous holes with light charges to avoid damage to the brick lining or falls of the soft shale roof.

When the heading work was first started at both ends, the muck was wheeled in barrows to chutes on both sides of the two approach cuts. These chutes delivered the spoil into small dump cars hauled by gasoline locomotives to convenient waste dumps.

After the main-line running tracks were gauntleted, it was possible to extend a narrow-gage service track



CARS ON SERVICE TRACKS receive spoil from chutes at 20- or 24-ft. intervals along both sides of tunnel. Note heavy timbering of old brick lining.

through the tunnel on both sides. Then, openings were made through the arch ring at intervals of 20 or 24 ft. directly over the two service tracks. This permitted chutes to be placed at these intervals so the spoil from the headings could be dropped directly into the cars below without hindering main-line traffic. After this scheme was adopted, the rate of progress on the headings nearly doubled.

When the heading from the west portal had been advanced 100 ft., removal of the brick lining was started from that end. Excavation of the rock to the new section lines back of the brickwork was carried ahead with the removal of the latter. All of the drilling, shooting and mucking had to be done so traffic was not hindered. By using numerous light shots that were put off when thin spots occurred in the traffic, there was very little delay to train movements. But all of the mucking had to be done by hand into light cars on the service tracks, since there was no room for mechanical equipment.

As fast as the old lining and the sidewall excavations of the new section were taken out, plumb posts were set for the heavy timber arch rings of the headings. By close follow-up and careful handling all movement of the arch rings was avoided, longitudinal lacing timbers being of much help.

MINE PROPS on old brick tunnel lining hold seamy shale roof until excavation is finished and arch rings of timbering are placed.

After the tunnel had been enlarged and timbered to the new section for a distance of 250 ft. from the west portal, pouring of the new concrete lining was begun. Meantime, wooden forms had been built for the new concrete portal so the latter could be poured first. Then the lining was carried forward with two sections of Blaw-Knox movable steel forms each 20 ft. long, which were advanced on traveler wheels, running on rails at the base of the sidewalls.

Concrete for the lining was mixed in a plant about 1,000 ft. from the west portal, which was as close as a satisfactory site and a location for a siding to serve it could be found. A 1-yd. mixer in this plant was set high enough to discharge by gravity into a 4-yd. hopper on a narrow-gage car at the ground level. This hopper car was shifted back and forth between the plant and the portal by a light gasoline locomotive. The scheme was for the hopper car to deliver to a portable pneumatic placing outfit that was run into the tunnel to the point where lining operations were in progress. In order that the hopper car could deliver to a supply bin on the portable placing outfit, a trestle was built up on one side of the portal. The hopper car was run up on this trestle and the portable outfit shifted directly under it to receive its load directly.

Air for the concrete gun on the portable outfit was supplied from a compressor near the portal. A line extended into the tunnel from the compressor with connections so the gun could take off with short pieces of hose. A receiver on the traveling outfit took the peaks of demand for air by the gun.

ARCH RINGS of timbering that support new excavation until permanent lining is placed. Top of old brick tunnel lining in foreground, with core of enlargement excavation section in background.

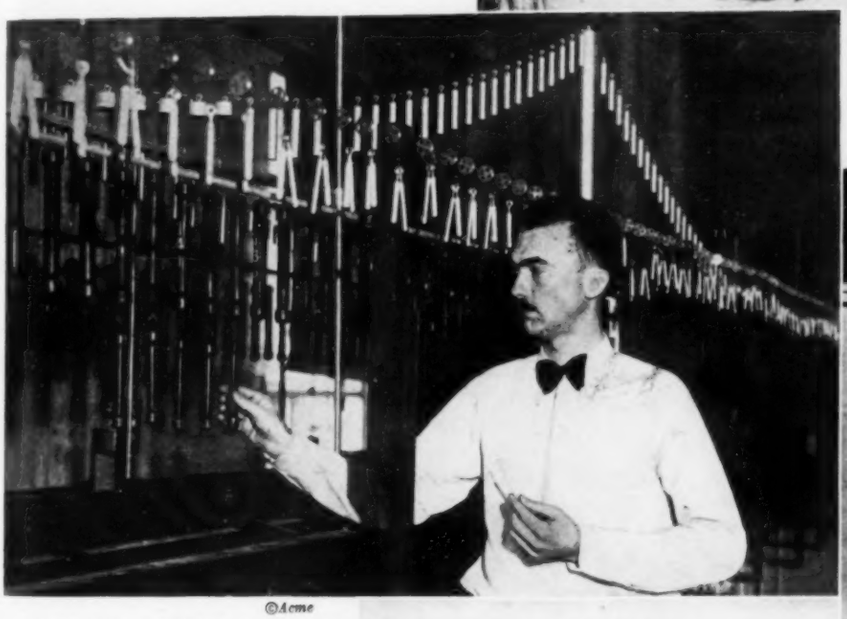
After the section of steel form was filled and allowed 36 hours to set up, all the concrete placing being done by the gun, the form was lowered and moved ahead. The rear end of the form was left in the front end of the finished concrete to assist in aligning and holding it accurately in place in the new set-up.

C. W. Johns is chief engineer of the Chesapeake & Ohio Railway Co., E. G. Rice is district engineer in charge of the section of the betterment program that includes this project, with J. A. Cooke as resident engineer and F. C. Cunningham senior inspector; Sturm & Dillard of Columbus, Ohio, were the contractors on all three of the projects, with D. W. Fraser in charge as superintendent.

JOB ODDITIES

A Monthly Page of Unusual Features of Construction

TRACTOR IN WINTER SPORTS ROLE. On vacation from road building work, Cletrac hauls bobsled teams to top of slide at Lake Placid, N. Y., scene of Olympic championships.



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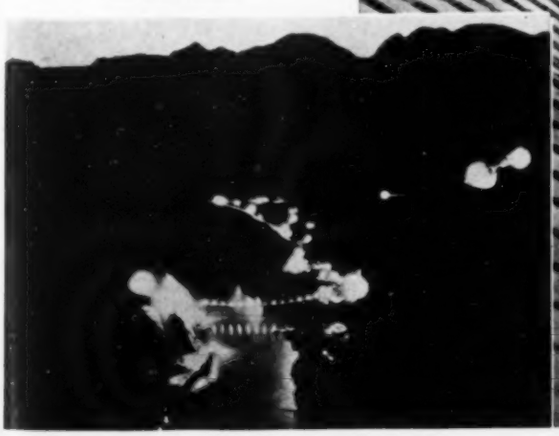
TO TEST STRESSES *(above)* in proposed $75,000,000 San Francisco-Oakland Bay suspension bridge, model of structure is built by California Department of Public Works. Weights hanging from top wires load suspension cables for 2,300-ft. and 3,800-ft. spans.

©Acme

MINIATURE BUILDER *(above)*. Arthur Weindorf, of New York Board of Transportation, reproduces on small scale, but complete in every detail, structures along routes of new subway system.

CONSTRUCTION'S GREAT WHITE WAY *(below)*. Electric lighting of Colorado River canyon facilitates night work by Six Companies, Inc., on Hoover Dam.

Has your job developed any ODDITY *that should be illustrated on this page?*



©Wide World

HEADWORK *(left)* of a special brand is required of these English workers engaged in placing a tile roof on a London house.

WHERE SLIPS OCCURRED. Highway route is on steep hillside along Ohio River and above railroad tracks.

Drainage System and Piling CHECK LANDSLIDE *Along River Highway in Ohio*

By EARL V. MURRAY
Ohio Department of Highways

ONE of the most formidable tasks in road building ever attempted by Ohio's highway department since its origin in 1904 was completed last year after almost three years of continuous work. Approximately $1,250,000 was spent on this project, which consists almost entirely of rough grading (unclassified) and the construction of drainage structures on the Ohio River Road between Pow-

AREA OF LANDSLIDE is indicated by white line. After 100,000 cu.yd. of overburden had been removed, a slip of 300,000 cu.yd., measuring 600 ft. in length at its base, occurred.

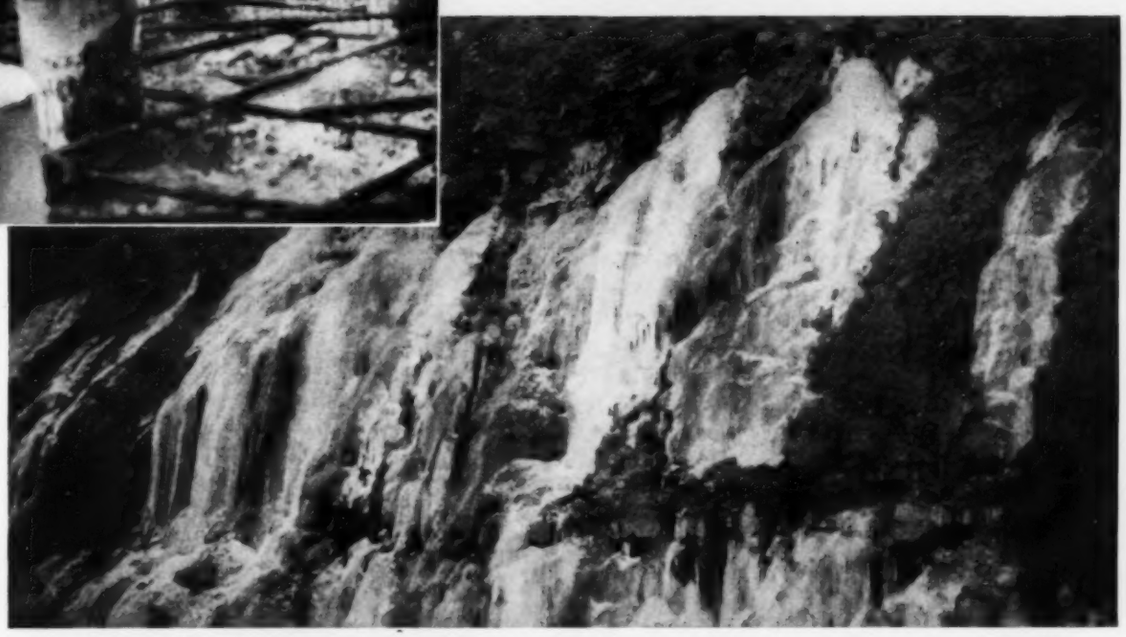
hatan and Shadyside, a distance of 10 mi. Practically any road improvement contract today presents its individual problems of unforeseen contingencies, but in the making of this improvement difficulties were encountered of such character as to tax not only the public funds, but engineering skill as well.

From a topographical standpoint Ohio is a fairly level state, with the exception of its southern portion, which is of a rugged character with hills more like small mountains, paralleling the Ohio River and forming its southern and southeastern boundary line. It is in this practically virgin country that the state of Ohio is locating a highway which, when completed, will establish a through route along the Ohio River from Pittsburgh to Cincinnati and likewise give relief to the southeastern counties as an outlet to the national road at Wheeling or other points along the river.

Because of the already existing right-of-way of the railroad, which acquired the best and only available alignment, it was necessary for the state's location engineers to accept the only alternative route at a higher elevation on the sides of the hills. Here cuts 50 to 150 ft. deep and 40 ft. wide were made on hillsides composed of coal, shale, clay and sandstone. Because of the disintegrated condition of the seams of shale, together with the broken condition of other strata caused by blasting and accentuated by seepage, a continual dribbling and sloughing off of debris was occurring the entire length of the project. While these conditions, in a greater or lesser degree, will probably continue for several years, and it will be necessary for the state to provide truck maintenance almost constantly, this article concerns chiefly the methods employed in the control of an unusually large landslide. Small slips and landslides on this improvement became a common occurrence. However, at one point more than 300,000 cu.yd. of earth and shale came down, completely covering the roadway and the right-of-way of the railroad 30 ft. below.

A careful study revealed that this was an old slide, having been active for years. The railroad, before the highway was located above it, had spent large sums of money each year clearing its tracks of fallen shale, rock and earth which this old slide kept continually pushing on to it.

While the excavation for the new highway which was located near the base of the slipping area, had disturbed



PILING *(above, left)* consists of 10-in. steel oil-well casing filled with concrete and capped with concrete reinforced with steel rail and bars. RETAINING WALL *(above, right)* protects railroad tracks. SEEPAGE *(below)* from water-bearing seams loosened material and caused slides.

EXCAVATING *(left)* at head of slip with power shovel. Slipping plane on ledge of tilted rock indicated.

MAKING FIRST CUT *(below)* for trench to receive perforated corrugated iron pipe drain. Finished drain is 20 to 30 ft. below level of this cut.

the old slide and caused the large movement, a further investigation disclosed that the slipping plane was solid rock. The movement was further activated by moisture from water-bearing seams and springs. Water, which had saturated the area so thoroughly, presented the main problem. It was evident that some adequate system of drainage was necessary to dry out and stabilize the area affected.

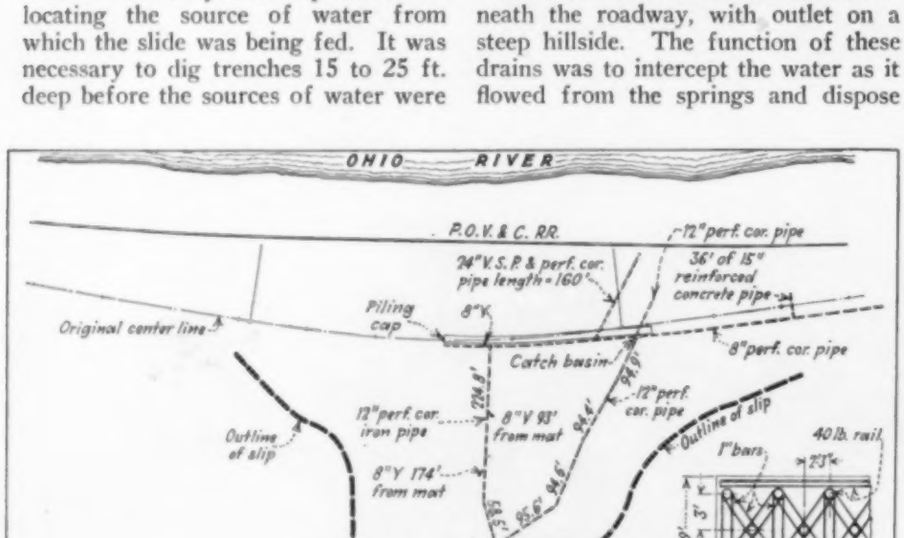
With great difficulty the overburden of approximately 100,000 cu.yd. was removed with a steam shovel which, at times, was nearly mired. After most of the surcharge was removed test holes were made at various points to determine stable rock which, in some places, was located at a depth of 50 ft., giving some idea of the immensity of the slide.

Much difficulty was experienced in locating the source of water from which the slide was being fed. It was necessary to dig trenches 15 to 25 ft. deep before the sources of water were found. The slip was in the shape of a large triangle, and the trenches were located along the sides of the area, extending to its apex. From this main trench were carried lateral French drains or feeders. In the trenches 8-in. perforated corrugated iron pipe in short lengths with collar joints were placed and covered with gravel. The main drains on both sides of the slide were extended down underneath the roadway, with outlet on a steep hillside. The function of these drains was to intercept the water as it flowed from the springs and dispose of it in the river below. The greater part of the moisture was thus removed from the slip, but the problem was not completely solved by the elimination of the flow of water into the slip.

Because of the massiveness of the slide area, its particular location and the possibility of wet seasons, it was deemed advisable to place the strongest available piling between the slip and roadway. Therefore, 10-in. oil well casings were drilled through the slip and 5 to 6 ft. into solid rock. Three rows of these casings were placed and set in a staggered position 5 ft. apart for a distance of 300 ft. The casings were filled with concrete and reinforced with a 40-lb. per foot steel rail.

In addition to this concrete reinforced steel casing, 1-in. reinforcing bars bent around the outside of each piling and laid in a concrete cap both at the top and bottom were used. Although some authorities may disagree as to the value of a concrete cap tying the ends of the piling together, it is believed that the additional tie bars used will, if the slide should exert a thrust upon any part of the piling, distribute the force over an area and thus provide a more uniform resistance.

This work was done under the direction of H. F. Brown, division engineer of the Ohio Department of Highways. The engineers supervising the construction were J. D. Fowler, E. H. Tilton and D. R. Severs.



DRAINAGE SYSTEM of perforated corrugated pipe carries water from slip area to river. Outline of slip indicated by dotted line. Sketch at right shows detail of piling and reinforced concrete cap.

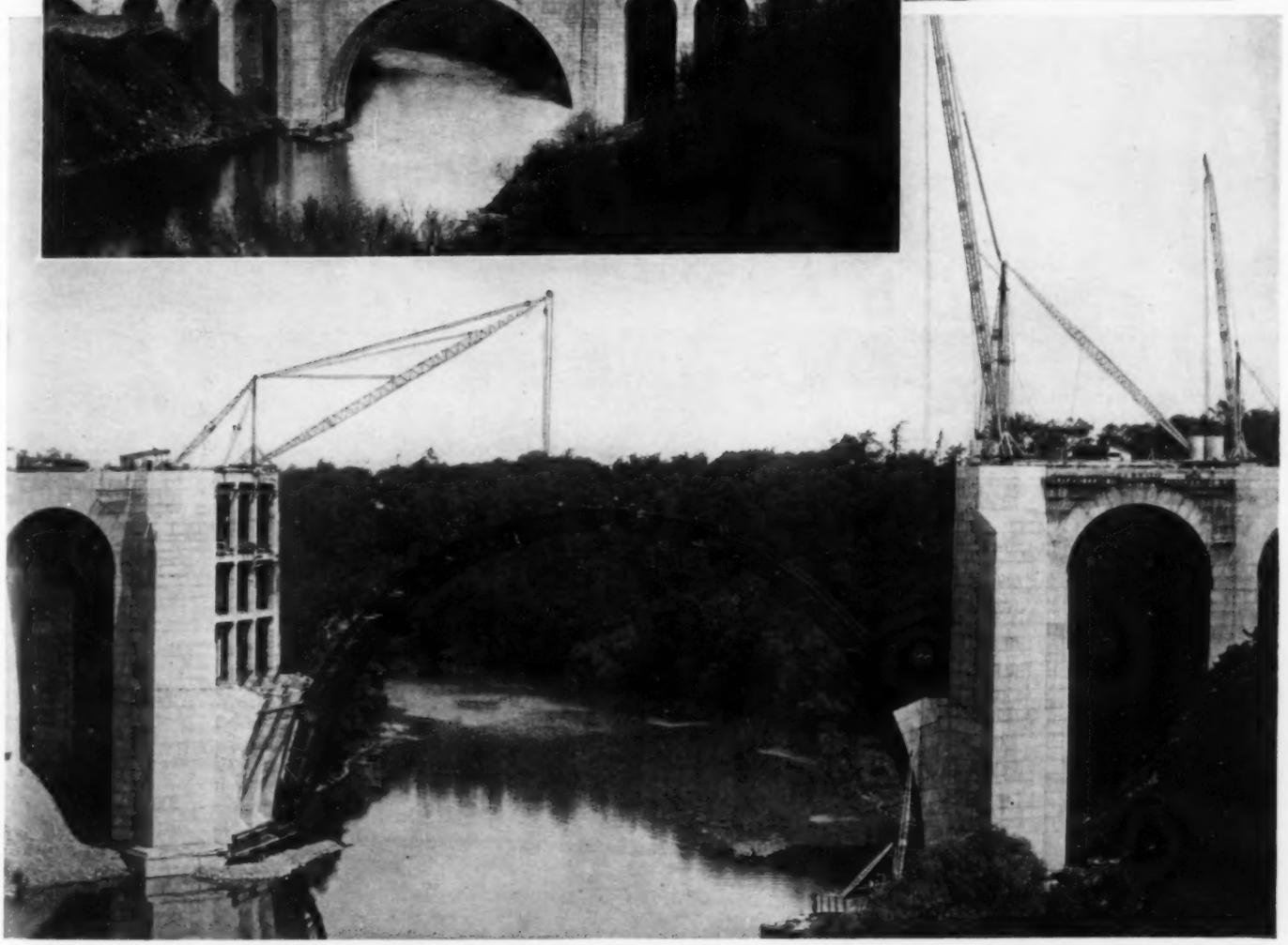
STEEL CENTERING

for Granite-Faced Concrete Arch Erected as Semi-Cantilever

IN BUILDING the Ridge Road bridge, a granite-faced concrete arch, over the Genesee River at Rochester, N. Y., Booth & Flinn Co., of Pittsburgh, used for the center span steel centering erected as a semi-cantilever with the aid of tiebacks. The bridge consists of a four-rib main arch, having a clear span of 150 ft., and six 58-ft. arches, three on each side. The total length of the bridge, including approaches, is 1,200 ft. The main roadway is 60 ft. wide and is flanked on each side by 9-ft. sidewalks.

For erecting the centering and delivering concrete, the contractor used a pair of stiff-leg derricks, with 200-ft. booms, one mounted on each river pier. These derricks were capable of handling 15-ton loads at a 150-ft. radius. In concreting the center arch, two ribs were poured in one operation. The steel centering was then moved sideways for the pouring of the other two ribs.

For the Booth & Flinn Co., A. Rex Flinn is president, George Hockensmith, vice-president and general superintendent, H. N. Crichton, superintendent, and C. L. Dorsey, assistant superintendent.



STEEL CENTERING in place for carrying forms for four-rib main arch. GRANITE FACING *(above, left)* is applied to concrete body of structure. TIEBACKS *(above, right)* for erecting centering as semi-cantilever.

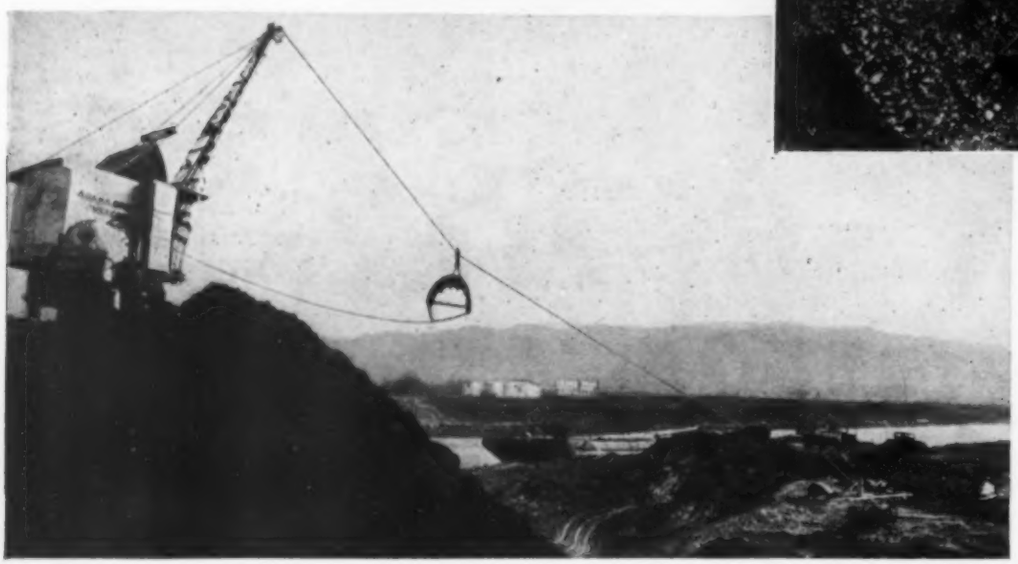
Getting Down to DETAILS

Close-up Shots of Job Methods and Equipment

FORM PULLER, made and used by Roberts Construction Co., of Lincoln, Neb., on 11¼-mi. concrete road job for State Highway Department of Kansas.

ALUMINUM ALLOY BOOM *(below)*, weighing only two-thirds as much as a steel boom of same length (75 ft.), handles 1¼-yd. bucket on Bucyrus-Erie dragline used by Dick Construction Co., of Hazelton, Pa., for anthracite coal stripping operation. Booms of this type are now made in lengths up to 175 ft. Advantages on dragline work are longer reach or increased bucket capacity.

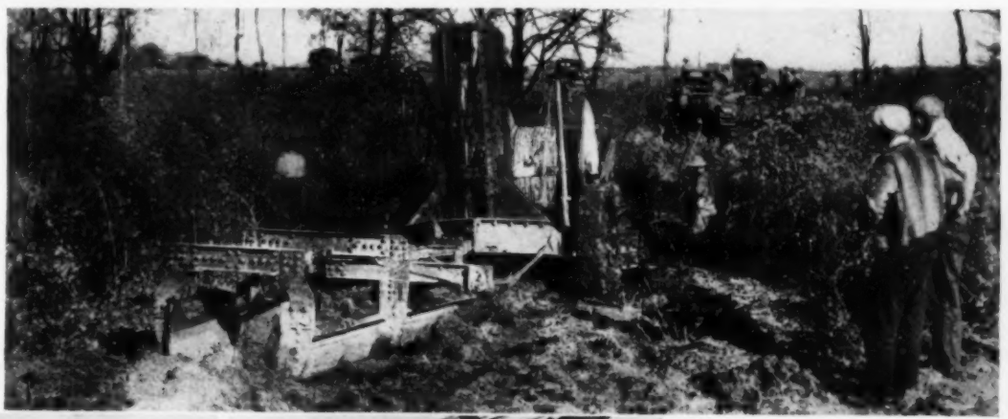
ALL-STEEL WALING AND SHEET PILING, installed by Great Lakes Dredge & Dock Co., forms breakwater along Lake Michigan shore for extension of Lincoln Park, Chicago. Structure is faced with Inland Steel Co.'s piling and waling of channels and bars.



DRAG SCRAPER IMPROVISED *(left)* by rigging 1-yd. Sauerman bucket on cable from 50-ft. boom of truck-mounted Bay City crane. Adams Bros. Construction Co., of Glens Falls, N. Y., use gravity-return outfit illustrated to build high, 20,000 yd. embankment for approach to railway bridge over Barge Canal at Comstock, N. Y. One drum of crane inhauls Crescent scraper bucket, while second drum tensions or slacks off slackline track cable. Cable passes over top of crane boom and out to a tail anchor.

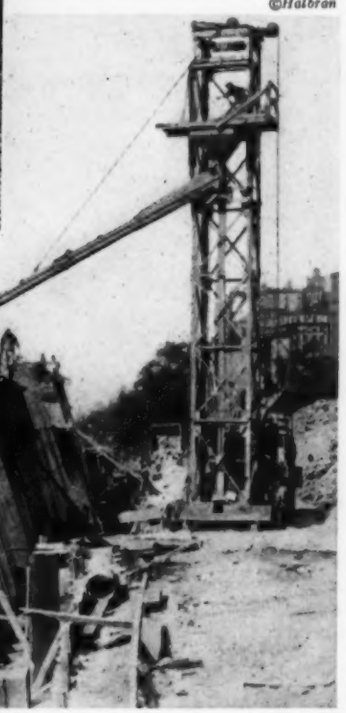
NO FALSEWORK. Cantilever method used to erect 42-ft. reinforced-brick arch span at Melrose Country Club, Philadelphia. Masons, using mortar of 2 parts Incor high-early-strength, 1 part Century natural cement and 6 parts sand, lay brick on wood center hung from completed portion of arch.

UNDERGROUND CABLE LINE *(right)* 75 mi. long between Syracuse and Watertown, N. Y., is laid by New York Telephone Co., using rooter plow hauled by two Caterpillar "60" tractors, in tandem, to break ground to 25-in. depth. Preliminary rooting is followed by tractor-hauled cable-laying outfit, consisting of cable-laying plow, cable-reel trailer and backfiller or "crowder," which laid cable to 30-in. depth at rate of 12,000 ft. daily.

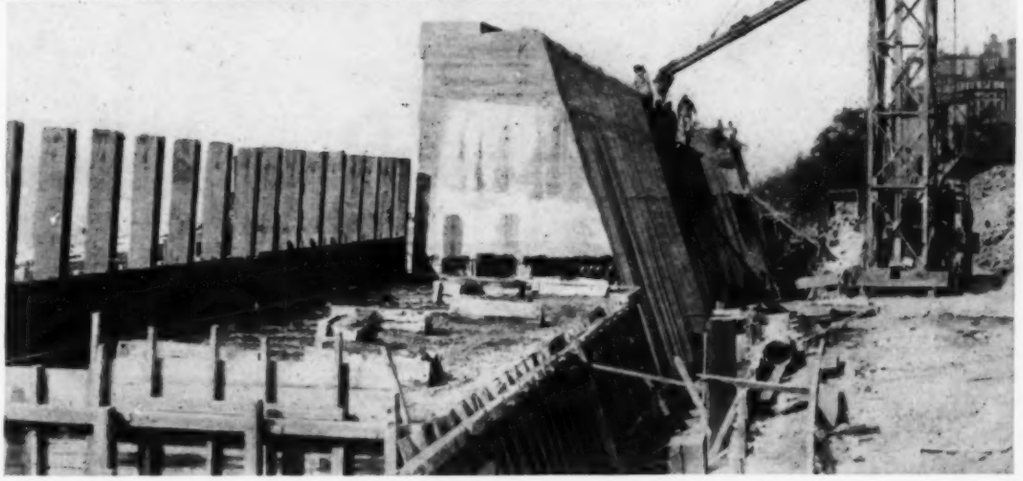


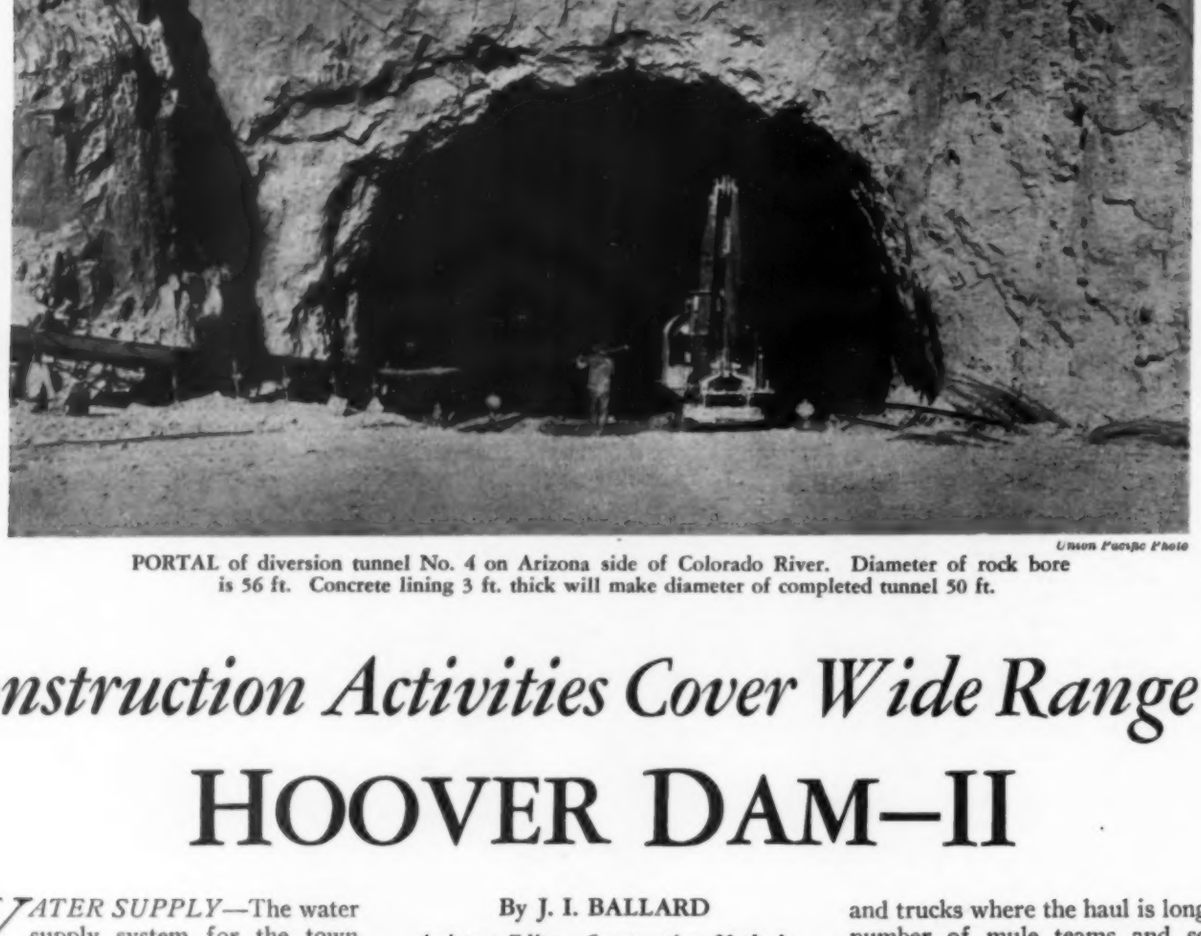
MOVABLE TOWER and chute *(below)* deliver concrete for 50-ft. retaining wall being built to form Riverside Drive Park, New York City.

©Halbran



ADJUSTABLE SPREADER *(above)* attached to rear of bottom-dump crawler wagons, enables H. H. Ruddell, contractor of St. Louis, Mo., to place earth fill in layers of desired thickness. Device is V-shaped steel plow which may be raised or lowered so that its bottom is above ground a distance equal to the depth of the required layer of the fill. — *Photos, courtesy Missouri Branch, Associated General Contractors.*





Union Pacific Photo

PORTAL of diversion tunnel No. 4 on Arizona side of Colorado River. Diameter of rock bore is 56 ft. Concrete lining 3 ft. thick will make diameter of completed tunnel 50 ft.

Construction Activities Cover Wide Range at HOOVER DAM—II

By J. I. BALLARD

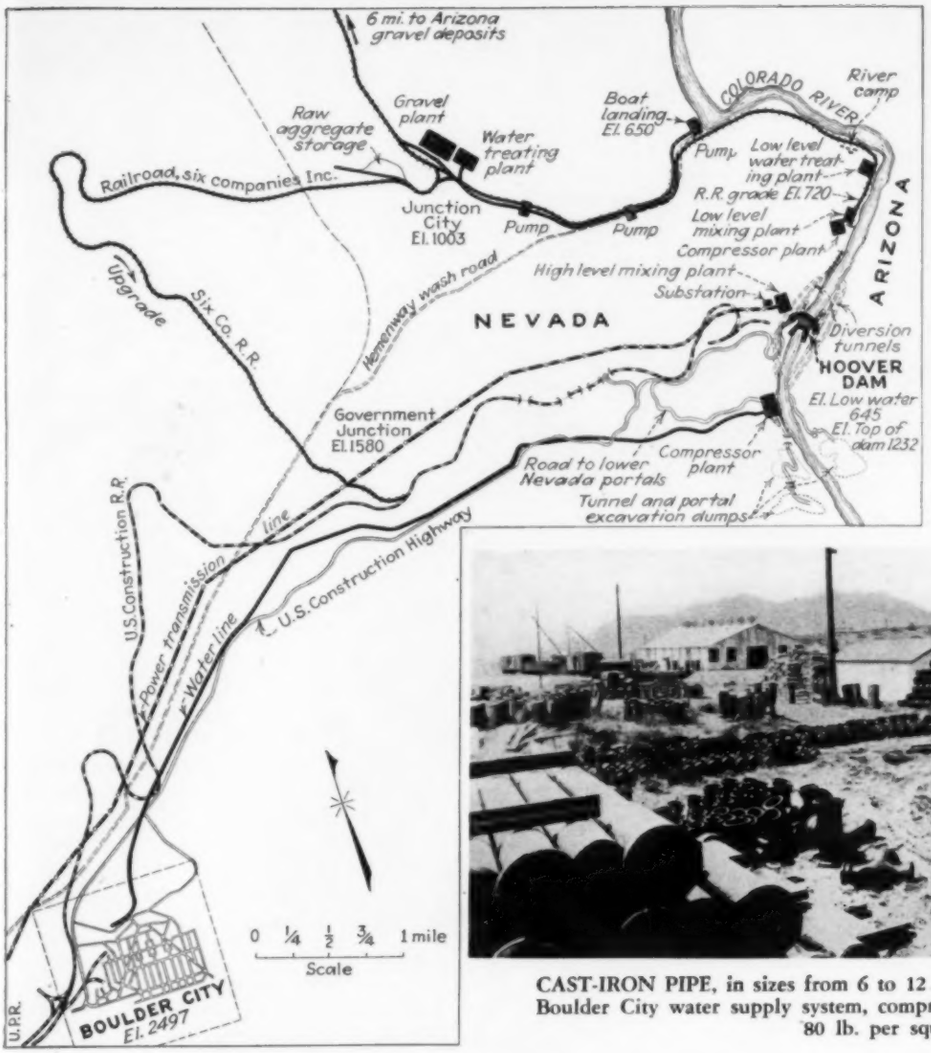
Assistant Editor, Construction Methods

WATER SUPPLY—The water supply system for the town consists of 10 mi. of cast-iron pipe water mains, varying in size from 12 in., near the storage tank, to 6 in. in the outskirts. The system includes 85 fire hydrants and operates under a static gravity head of 80 lb. per square inch from the main storage tank.

Streets—Grading for the streets required the removal of approximately 150,000 cu.yd. of material, mostly sand. This grading is being done by tractor-drawn scraper equipment, for the most part augmented by shovel and trucks where the haul is long and a number of mule teams and scrapers where the grading is light. This work follows the completion of the trench backfilling and, in turn, will be immediately followed by the street-surfacing operation. The business streets will be paved with a two-course layer of asphaltic concrete 5 in. thick for a width of 56 ft. Some of the secondary streets will be surfaced with a water-bond macadam base, 3 in. thick, covered with a 2-in. top coat of asphaltic concrete, and the residential streets will have a surfacing of oil-treated gravel. The estimates for these three classes of street surfacing construction are 46,000, 44,000 and 128,000 sq.yd., respectively. In addition, there will be laid 94,000 lin.ft. of combined curb and gutter, 180,000 sq.ft. of 4-in. concrete sidewalk and 190,000 sq.ft. of gravel sidewalk.

SUSPENSION BRIDGE across Colorado River erected by Six Companies, Inc., immediately above diversion and penstock tunnel inlets.

Boulder City Government—The municipal government will be of the city manager form under the direct supervision of the project's construction engineer, Walker R. Young. Sims Ely, recently appointed city manager, will be in direct charge of all municipal activities including the water supply system, street work, parks, collection of rentals from concessions, and other functions common to city manager



LOCATION MAP showing position of Boulder City, Nev., with respect to Hoover dam site and routes of highway, railroad and water supply lines. Also, sites of gravel, concrete mixing, water treatment and compressor plants and dumps for tunnel spoil.

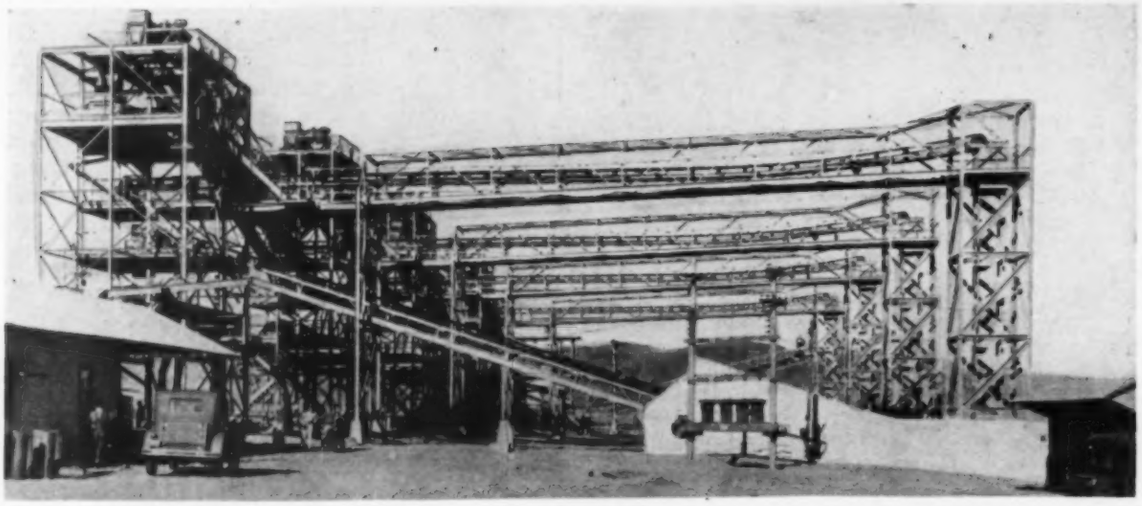
responsibility. The personnel of this city operating force will be expanded as necessary. An advisory commission of three members, two representing the Bureau of Reclamation and one the Six Companies, will advise and consult with the construction engineer and the city manager on municipal affairs.

On Oct. 1, 132 applications for permission to establish business enterprises had been approved. These applications involved every type of business enterprise from professional services, such as doctor and lawyer, to movies and stores. Such applications have been studied in great detail and ratings made according to experience and financial responsibility. Those of the higher ratings have been granted first in cases of restriction as to number to be approved. Property for the erection of such businesses will be in lease form for a 10-year period based on the actual appraised value of the property to be used. In addition, residential property will be leased under the same general provisions. This is in addition to the land occupied by the Six Companies which is rented according to the terms of the general contract for a fixed sum of $5,000 per month including the use of municipal facilities.

Naturally, the size and character of the town after the project construction work has been completed cannot be fixed. It will be the home of the operating force at the dam and power house which will be a nucleus for a permanent city. In addition, it will be on the main highway from Nevada across the dam into northern Arizona, a route now impassible. In addition, it will be a point of great tourist in-

CAST-IRON PIPE, in sizes from 6 to 12 in., is stored at yard ready for use in Boulder City water supply system, comprising 10 mi. of mains under head of 80 lb. per square inch.

CONSTRUCTING RIVER ROAD, with heavy grading done by electric power shovels. View taken looking upstream from point below lower portals of diversion tunnels.



SAND AND GRAVEL washing and screening plant under construction by contractor to supply 500 tons of aggregates per day to concrete mixing plants.

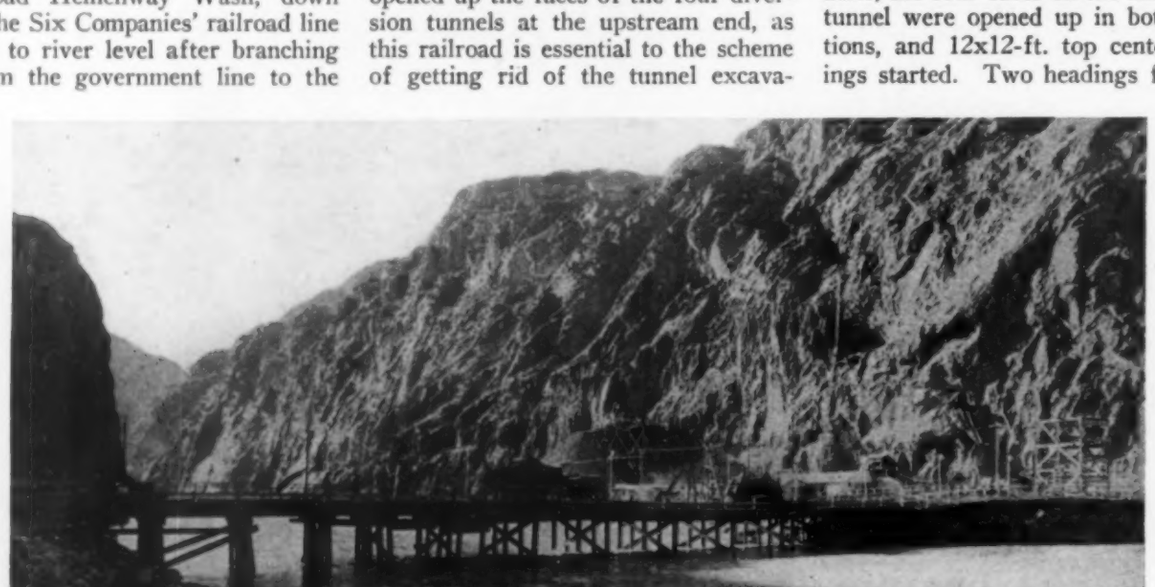
terest, but the actual municipality that can be expected to maintain after the present operations is rather speculative.

Work on Main Contract — From Boulder City a fine oiled highway built by the government as part of the permanent route to be built south across the completed dam extends about 8 mi. to the rim of the canyon above the dam site. In the section of country between these points the contractor has been rushing railroad construction down to the river and into the gorge from the upstream end of the canyon and north to the Arizona gravel deposits. At the same time the preliminary work of getting a road down to the downstream portals of the diversion tunnels has been under way.

The highway to the canyon overlooks the broad Hemenway Wash, down which the Six Companies' railroad line extends to river level after branching off from the government line to the rim. Under a private contract the construction of this railroad is well advanced and the north branch has been graded a distance of 14 mi. to the river across from the gravel beds. Here a railroad bridge will be built and the gravel loaded directly into the trains. The south branch is being run into the canyon to the actual dam site. This latter branch has necessitated extremely heavy rock excavation, including the driving of a 1,000- and a 500-ft. tunnel near the site. This railroad will serve many purposes, including bringing supplies and cement to the site, the bringing in of aggregate and the removal of tunnel muck from the upstream end of the diversion tunnels.

Tunneling—Pending completion of this railroad, the contractor has only opened up the faces of the four diversion tunnels at the upstream end, as this railroad is essential to the scheme of getting rid of the tunnel excavation. Access to the downstream end of the diversion tunnels has been gained by a construction road leading from the end of the government road on the canyon rim down a rocky draw, a drop of 800 ft. to water level at the location of the downstream portals on the Nevada side. This permitted work to be started on opening up the faces of the four tunnels from the downstream end and provided some incidental pay work on the permanent highway that will eventually reach across the dam.

To expedite tunnel driving, adits on both sides of the river were opened up at about the center of the 4,000-ft. length of diversion tunnels and driven to intercept both tunnel lines on each side. With completion of these 8x8-ft. adits, the four faces on the main 50-ft. tunnel were opened up in both directions, and 12x12-ft. top center headings started. Two headings from the



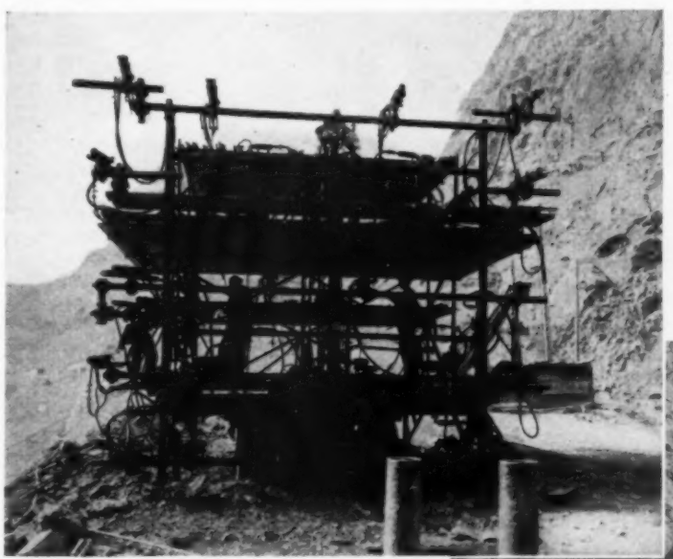
TRESTLE BRIDGE of wood construction across river above dam site provides crossing for trucks hauling loads of tunnel muck from Arizona to Nevada side.

HIGHWAY CUT, 60 ft. deep, is taken out by R. G. Le Tourneau, Inc. Shovel loads excavation into large-capacity, wide-tired, tractor-hauled "chariots."

CONCRETE MIXING PLANT of immense size begins to take form on Nevada side of river. Output of plant will be used first for lining diversion tunnels.

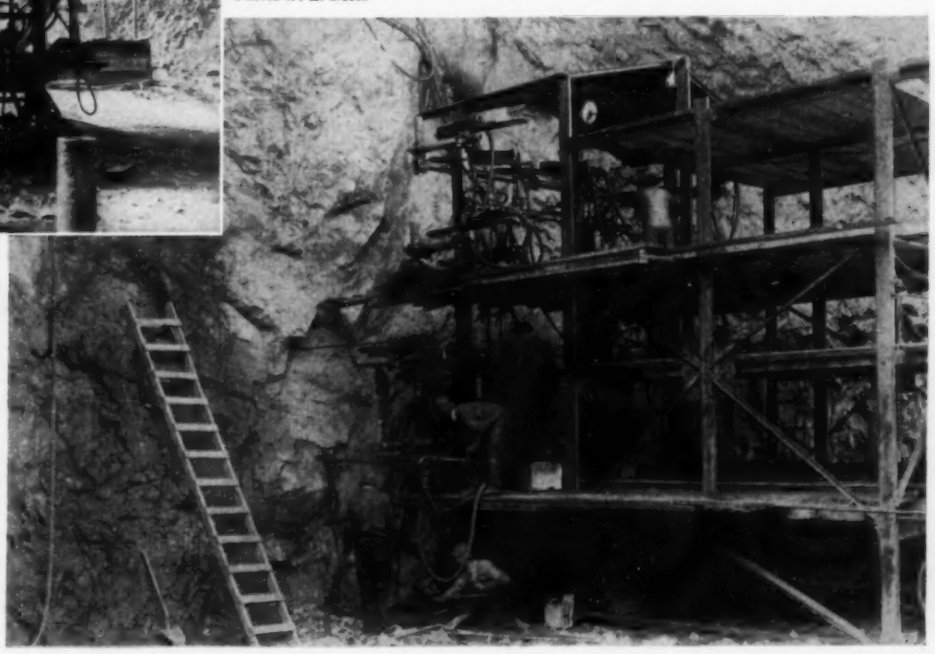
adit downstream to the portal have been holed through at the present time and experiments are now under way to determine the most effective means of enlarging these to the full 56-ft. diameter bore. The downstream portal of the outside tunnel on the Arizona side has been opened up as a full section and various means of driving are being tried. Up to the present time, the contractor has been favored by an exceedingly low flow in the river and has not attempted to open up the tunnel portals below river level. Therefore, there has been no necessity for cofferdams at the tunnel portals, but it will eventually be necessary to cofferdam off these tunnel portals.

Three main compressor plants electrically operated with 6,000 cu.ft. of Ingersoll-Rand compressor equipment have been established, one at the upstream portals, another at the adit and another at the downstream portal. These plants are practically similar in design, and the compressed air is piped across the river at each location on wire cable suspension spans.



SPECIAL JUMBO *(left and below)* **for carrying 25 tunnel drills on five horizontal bars is welded steel frame mounted on motor truck for movement to and from face of 56-ft. diameter rock bore.**

Photos W. A. Davis



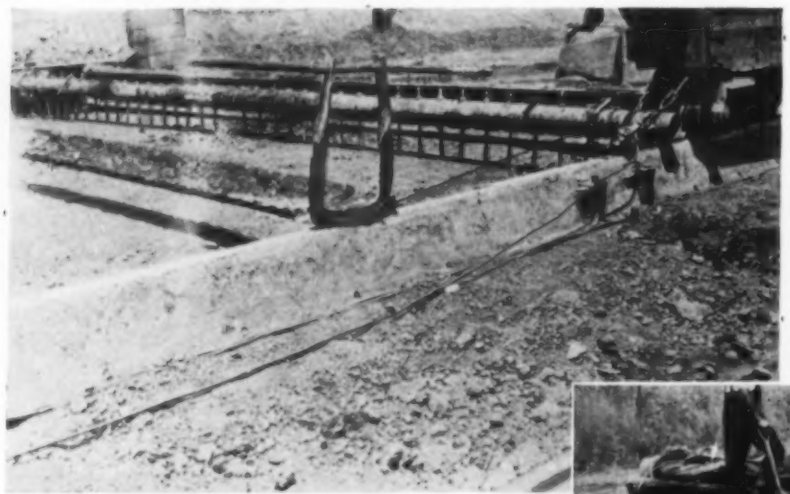
Spoil from the tunnels, according to the contract, cannot be dumped into the river and, as a result, the contractor, during the present operations on the downstream section, is building truck roads to permit dumping of the material in draws on the canyon side. Permission is given to waste sufficient material in the edge of the river to provide a trucking road and the remainder will be deposited out of the canyon.

For the U. S. Bureau of Reclamation, Walker R. Young is construction engineer in charge of the Hoover dam work. Construction by Six Companies, Inc., is in charge of Charles A. Shea, director, and Frank T. Crowe, general superintendent.

Step-by-Step Wire Fabric Reinforcement Placed by

THE accompanying photographs show in sequence the various steps in making the preliminary strike-off of concrete on a typical highway paving project, prior to installing sheet reinforcement, by the "cable-to-finisher" method.

This particular method of making the strike-off was developed during the last construction season and has been tried out on full length paving projects in at least five states. It makes possible the accurate positioning of sheet reinforcement without special equipment or extra labor and causes no paving delay whatever as



1 CONNECTIONS of cable and strike-off template. Template is shown resting on forms with subgrade scratch board in background attached to mixer. A ¼-in. cable is connected to end of strike-off template and run forward toward mixer through a pulley block attached to subgrade scratch template. Then cable runs back along forms on shoulders. Type of strike-off template suggested may be made by placing four ¼-in. angles back to back, angles having 3- or 4-in. legs. Such a template does not overturn.

2 SHOVEL MEN doing usual spreading of concrete in pit prior to making preliminary strike-off. Actually less spreading work is necessary where strike-off is made by this method, since template in moving forward accomplishes a large amount of this work. Strike-off template, covered with burlap, may be noted at rest in foreground of picture. The concrete nearest the camera has been struck by the template.

3 CABLES have been picked up from shoulder and attached to framework of finishing machine. Finisher has backed away about 6 ft., pulling strike-off template ahead an equal distance, and preparing level bed of concrete to receive reinforcing sheets. Cable is connected to finishing machine by loop in cable. Other successful methods employ half-hitch or hook. Better, cable may run through free running clamp on side of finisher, and may be picked up by operator simply throwing over a lever which thrusts a toggle block into the clamp to engage the cable. Important feature of this method is that finishing machine does not have to maneuver to any position to pick up cables, but may engage them, without hook-up men at any point where it may happen to be at the time when a strike-off is to be made.

4 STRUCK BED of concrete is ready for placing of reinforcing sheets. Note strike-off template just in front of bucket. When concrete has been struck, cables are disconnected from, or released, by finishing machine, and latter resumes its regular work.

Field Methods

"Cable-to-Finisher" Strike-off Method

compared to similar jobs without reinforcement.

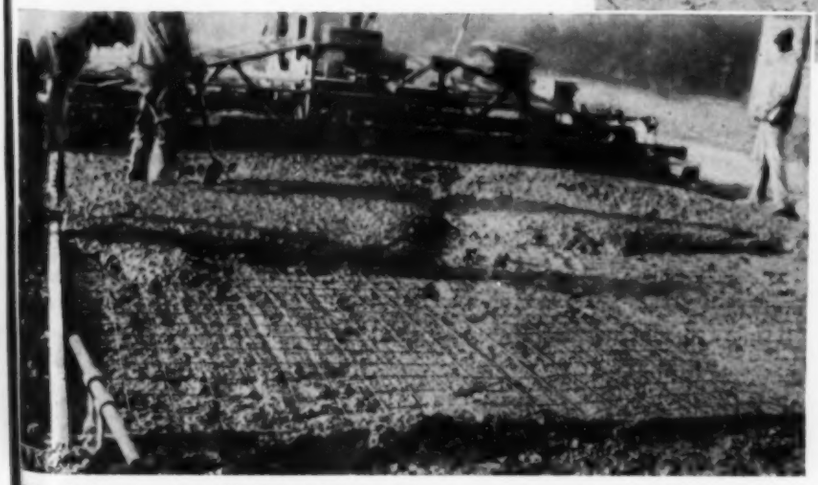
The available pulling power of the finishing machine is utilized to pull the strike-off template ahead by backing the finishing machine away, the work being done at a period during paving operations when delay is least likely to be caused, and done by the finishing machine wherever the latter may happen to be at the time when a strike-off is required.

Records in numerous cases show that paving progresses rapidly with this method. On one cost-analysis job it was found that the total cost of hauling out, distributing and installing sheets of wire fabric reinforcement by this method was less than 1c. per square yard.

5 SHEET of fabric reinforcing is laid by two men on struck bed of concrete. There are no connections to make or supports to bother with. The sheet is simply laid on the struck bed and is immediately ready to receive a cover batch of concrete.

6 CORRESPONDING SHEET of fabric reinforcing is laid on opposite side of the road. It may be noted in this picture that although the first sheet has been in place for perhaps 20 sec. or more, the next batch of concrete is not yet ready to be placed. Thus, as is always the case with this method, the reinforcement is installed faster than the paver can pour concrete.

7 BUCKET is being run out to drop cover batches on sheets of reinforcement. Normally only two batches, one on each side, are necessary to finish pouring of pit, following which mixer immediately moves ahead to pour next pit. Having moved, mixer does not have to wait on the placing of chairs or other supporting devices for the reinforcement, and may, therefore, begin dropping batches as soon as they have been properly mixed.



8 COVER BATCHES *(left)* have been deposited and finishing machine is doing its usual work in screeding surface to final grade. The strike-off template may be observed in the immediate foreground.

NEW EQUIPMENT *on the Job*

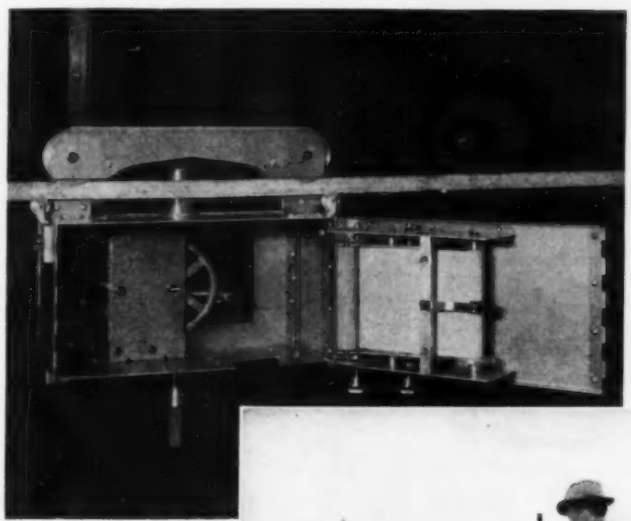
TRACTOR-MOUNTED DERRICK *(left)*, operated with cable-controlled power unit, used for laying concrete or steel pipe and for loading and unloading heavy construction equipment. Length of boom, 22 ft. Capacity 10,000 lb. Boom can be removed from subframe by drawing two hinge pins. Hoist cable, $\frac{3}{4}$ in., with 6 lines. Gantry frame or suspension cable, $\frac{1}{2}$ in., with 7 lines. Powered by Le Tourneau double power control unit with 8-in. drum.—R. G. Le Tourneau, Inc., Wilson Way at Roosevelt St., Stockton, Calif.

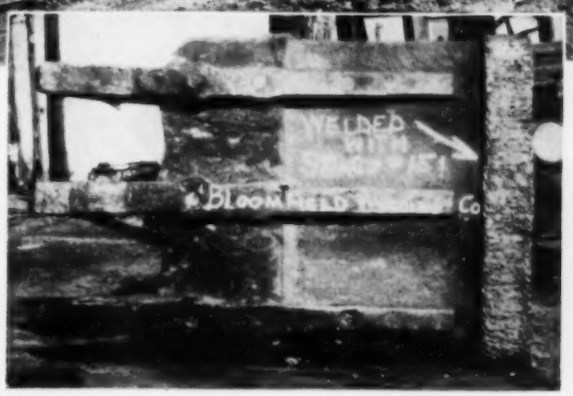
DIESEL-POWERED LOCOMOTIVE in 6-, 8- and 10-ton models for all kinds of material hauling. On average haul of 400 ft. machine illustrated *(left)* moves 778 loaded cars and 229 empty cars in 65 hr. for White Lumber Co., at Enumclaw, Wash., at total fuel cost of $2, or 25c. per 8-hr. day. Powered with Cummins Diesel engine.—Fate-Root-Heath Co., Plymouth, Ohio.

SUPER-CORRUGATED METAL PIPE *(right)* made of heavy plates with 1½-in. deep corrugations 6 in. from crest to crest. Plates shipped nested and are bolted together in the field to form 60-, 75-, 90-, 105- or 120-in. diameter pipe. First installation of multi-plate pipe *(right)* made by Drainage Engineering Co. under a railroad near Jackson, Miss., to replace arch bridge which failed. Pipe used was 90 in. in diameter, 125 ft. in length with 5-gage invert and 8-gage plates on remainder of circumference.—Armco Culvert Manufacturers Assoc., Middletown, Ohio.

MECHANICAL SPREADER AND SURFACER *(left)* for distributing bituminous road materials uniformly. Moves forward at rate of 12 to 15 ft. per minute. Blade in front of machine mixes and distributes material to V-shaped leveler or spreader which splits windrow and spreads material out to side runners set to desired width of road.—Heltzel Steel Form & Iron Co., Warren, Ohio.

LEANING WHEEL GRADER *(right)* equipped with 23-in. high blade and 90-lb. railroad rail stiffener. Frame consists of two 12-in. channels (weighing 35 lb. to the foot) to which top and bottom plates are continuously welded. Bottom plate extends entire length of frame. Heavy Z-shaped members form draw frame for one-piece, cast steel circle. Rear axle constructed of high carbon steel angles. Front axle and king post securely welded as a unit. Engine hitch of built up channel construction. All principal gears have machine cut teeth. All-steel vertical lifting arms have at each end drop forged ball joint sockets.—Austin-Western Road Machinery Co., 400 N. Michigan Ave., Chicago, Ill.





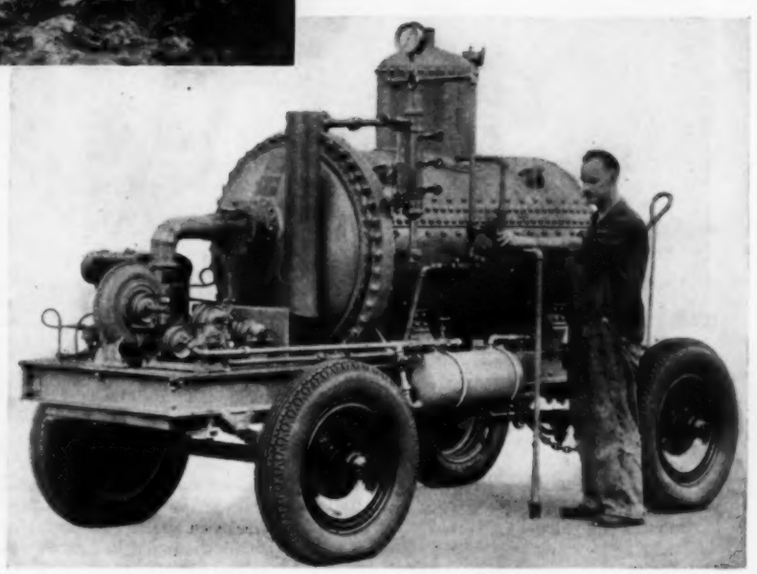
BUCKET reclaimed by means of manganese alloy Tight-Kote electrodes with which middle tooth was built up. Electrodes available in the following sizes: $\frac{1}{4}$-, $\frac{5}{16}$-, $\frac{3}{32}$- and $\frac{1}{4}$-in. diameter; 14-, 18-, 24- and 36-in. lengths or in coils.—Stultz-Sickles Co., 134-142 Lafayette St., Newark, N. J.

TO FACILITATE PLOTTING *(above and right)* of road cross-sections and to record on section paper the horizontal and vertical measurements more accurately, Karto-Graf has been designed by C. P. Dannenburg and Harry Whitaker, of Wilmington, Del. To operate device suitable support is provided for track on which instrument is placed and in a few second's time a profile of the side bank, gutter and shoulder is available for checking against the engineer's plotted sections.—Horace W. Scott, 2505 Jefferson St., Wilmington, Del.

If You Want Further Information

Within the space limits of these pages it is impossible to present complete information about the products illustrated.

The manufacturers, however, will be glad to supply further details if you will write to them, referring to this issue of *Construction Methods.*



TANK CAR HEATER *(right)*, portable unit provides steam for quick heating of railroad tank cars containing asphalts, tars, road oils and other viscous materials, thus making handling easier. Equipped with 30- to 50-hp. boilers, an oil burner and a 3-hp. Harley-Davidson gasoline engine for driving the blower, the water pump and the fuel pump. Self-contained water tank and fuel tank provides supply of water for day's operation. Alemite lubrication keeps all parts in working order.—Cleaver-Brooks Co., 740 N. Plankinton Ave., Milwaukee, Wis.

Present and Accounted For —

A Page of Personalities

THOMAS H. MACDONALD, chief of the U. S. Bureau of Public Roads, is the first recipient of the newly established George S. Bartlett Award "for outstanding contribution to highway progress." The award was endowed jointly by members of the American Association of State Highway Officials, the American Road Builders' Association and the Highway Research Board, in recognition of Mr. Bartlett's 43 years of service in the cement industry and his work in the cause of highway development.

JOHN LOWRY, president of John Lowry, Inc., New York building contractor, recently completed a monumental task as chairman of the committee of the Merchants' Association which has revised and modernized the building code of the City of New York. The work required three years and involved 476 committee meetings. Highest appreciation of the public service rendered by Mr. Lowry and his committee has been expressed by Mayor Walker and by the New York Building Congress.

E. A. HERRICK is the newly elected president of the General Contractors' Association of New York. He is president of the Oakdale Contracting Co. and vice-president of the Cornell Contracting Corp. His most recent work has been on the construction of New York's new subway system.

New Honorary Members of American Society of Civil Engineers

GEORGE H. PEGRAM, chief engineer of the Interborough Rapid Transit Co., and the Rapid Transit Subway Construction Co., of New York City, has been engaged in civil engineering practice for 54 years, most of the time in railroad work.

DANIEL W. MEAD is professor of hydraulics and sanitary engineering at the University of Wisconsin. He has specialized in the design and construction of water-works, irrigation and hydro-electric projects and has done extensive work as a consultant in these fields.

PALMER C. RICKETTS is president of Rensselaer Polytechnic Institute, Troy, N. Y. In addition to his collegiate work, he has served as bridge engineer and consultant on numerous engineering projects. He was a vice-president of the society in 1916-17.

GEORGE W. KITTREDGE has had a long professional experience in the railroad field, having served as chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railroad and of the New York Central Railroad. He is now consultant on valuation.

The PENNSYLVANIA HIGHWAY DEPARTMENT *said to* BYERS

"WE'LL TAKE SEVEN"

One of the seven Byers owned by the Pennsylvania Highway Department at work in slate pile at Cramer Camp Project, Cramer, Penna.

SO, all winter seven Byers shovels and camps of thousands of men brought good secondary roads right past Pennsylvania farmers' doorsteps.

Thousands of yards of red dog, blue slate, natural stone and other materials were fed to State road gangs by these dependable shovels. The seven Byers shovels *were expected to produce*—steadily and dependably. They did. They still are. And they will continue throughout months to come.

If this reliable operation is what you need on your jobs, *choose Byers.* You can't do better at any price. Sizes from 1¼ cu. yd. down to ⅜ cu. yd.; full revolving and part swing. Investigate which of Byers 26 models you need.

SHOVELS AND CRANES · BYERS GOLDEN ANNIVERSARY · 1883–1933 · O. · H. · I. · O. · U. · S. · A.

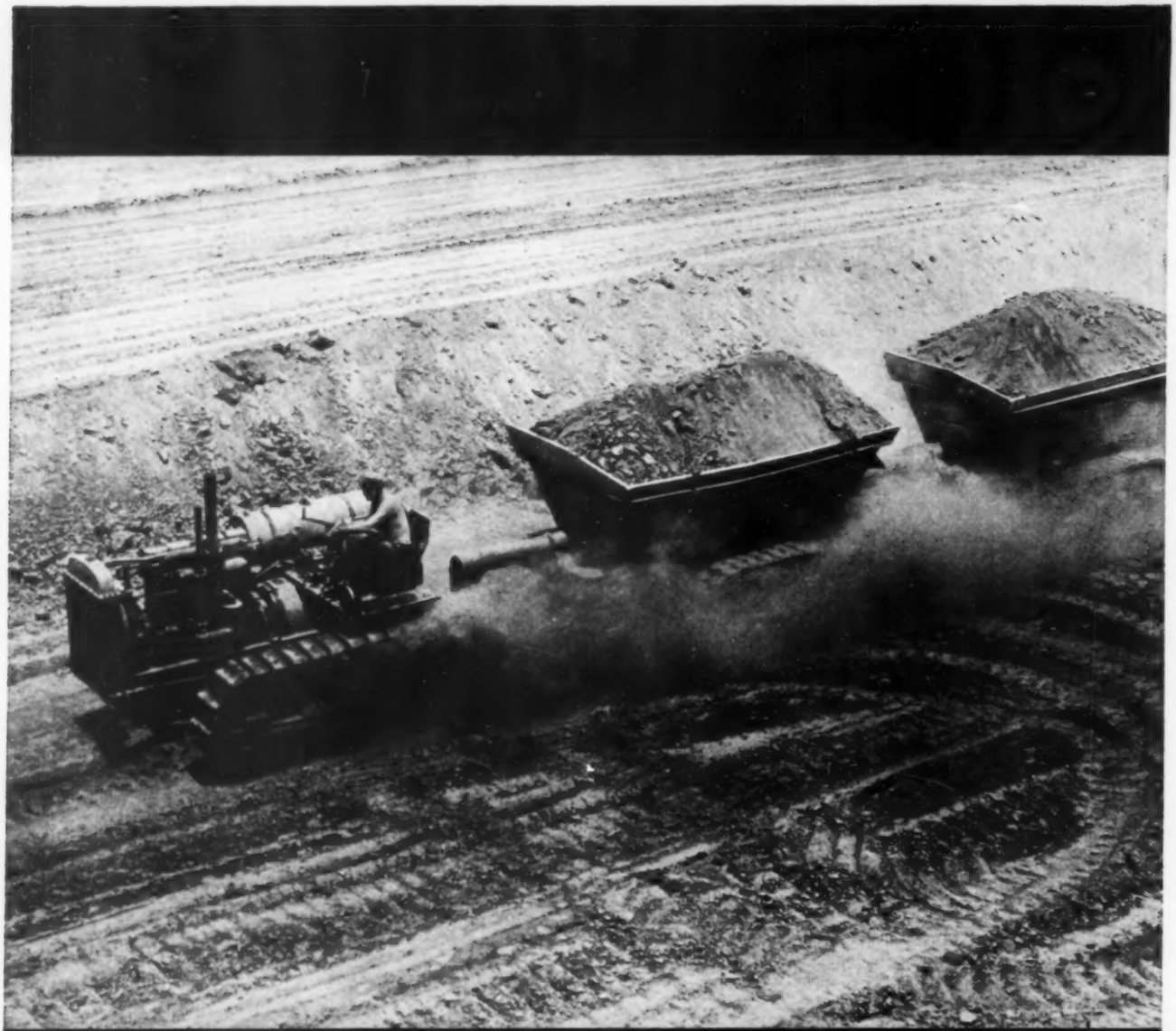
THE BYERS MACHINE COMPANY, RAVENNA, OHIO

Improved Sales and Service throughout the Country

BYERS

RAVENNA · OHIO

⅜ · ½ · ¾ · 1 · 1¼



"Caterpillars" stand out because they stand up

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.
Track-type Tractors Road Machinery
Combines
(There's a "Caterpillar" Dealer Near You)

Prices—f. o. b. Peoria, Illinois

TEN	$1100	THIRTY	$2375
FIFTEEN	$1450	FIFTY	$3675
TWENTY	$1900	SIXTY	$4175

CATERPILLAR

REG. U. S. PAT. OFF.

TRACTOR

THE first choice of the contractor is the "Caterpillar." He knows the superior stamina that is revealed by two, three, four years of the hardest work. He knows how slowly heat-treated steels yield to dust and mud. He recognizes the higher "turn-in value" of "Caterpillars." He appreciates the uninterrupted service built-in to meet the hardest conditions of ground and weather. The longer the investigation of the tractor market the surer the choice of "Caterpillar" track-type Tractors.

In every drop of COLAS (REG. TRADE MARK)

1,000,000,000

(A Billion)

particles of Asphalt!

No wonder a COLAS Road means MAXIMUM penetration and binding with MINIMUM asphalt! No wonder COLAS can be applied COLD—yet deposit perfectly a thin even film of pure asphalt around every piece of aggregate.

COLAS is an emulsion of pure asphalt. It is the result of intensive research over many years. Today it takes 82 factories throughout the world to keep up with the ever-increasing demand for COLAS Roads.

COLAS is the ideal binder for the low cost road. It requires the minimum of equipment. The pure asphalt is evenly distributed throughout the pavement, insuring longest life at lowest cost. COLAS Roads from arctic regions to the tropics have demonstrated that COLAS means elimination of waste asphalt, bleeding and skidding. Experienced COLAS Engineers are available in all parts of the country.

SHELL OIL COMPANY
San Francisco
SHELL PETROLEUM CORPORATION
St. Louis
SHELL EASTERN PETROLEUM PRODUCTS, INC.
New York City
Licensees of Colas Roads, Inc., New York City

(AT LEFT)

SPEED *where the going is easy*

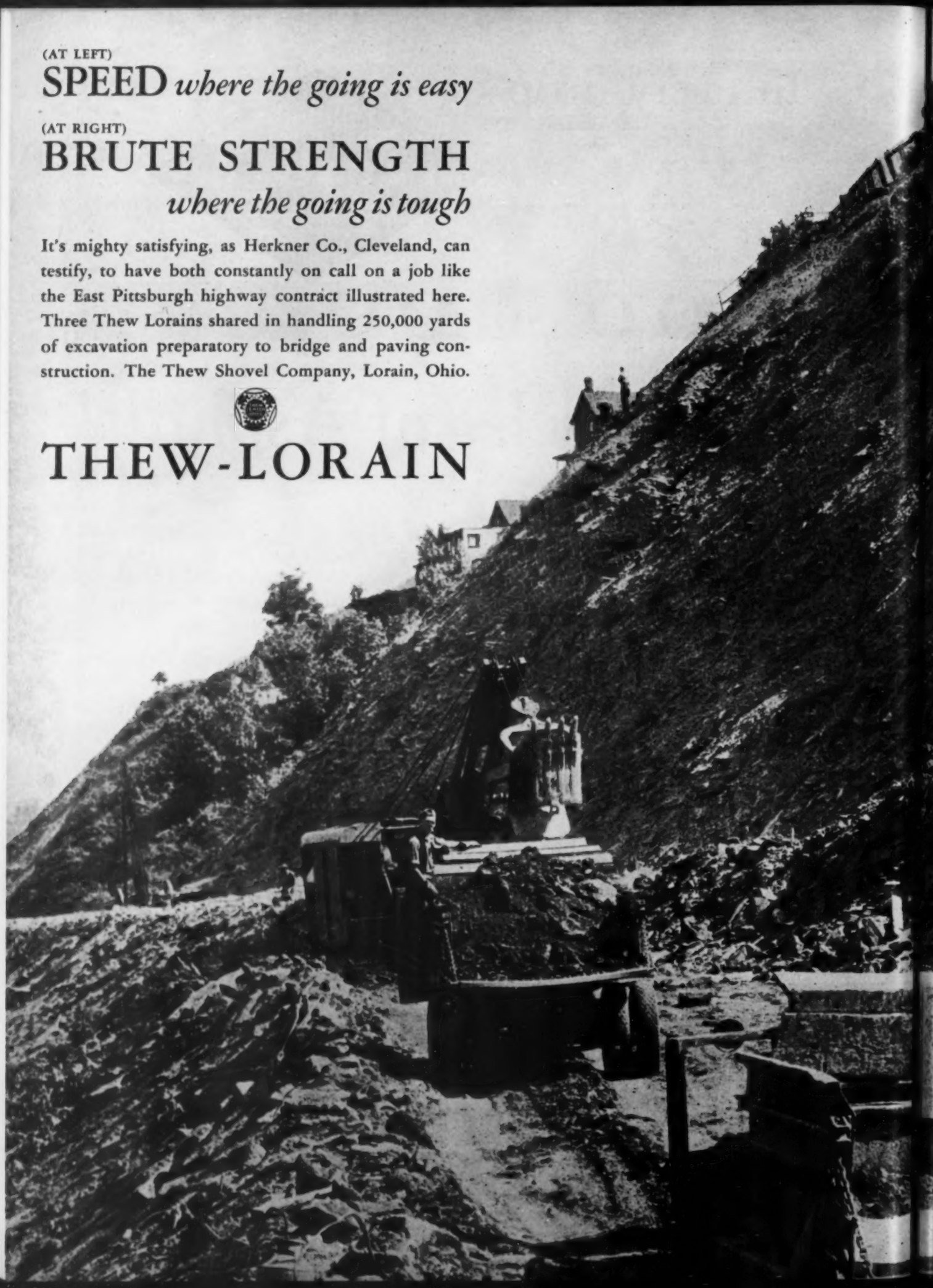
(AT RIGHT)

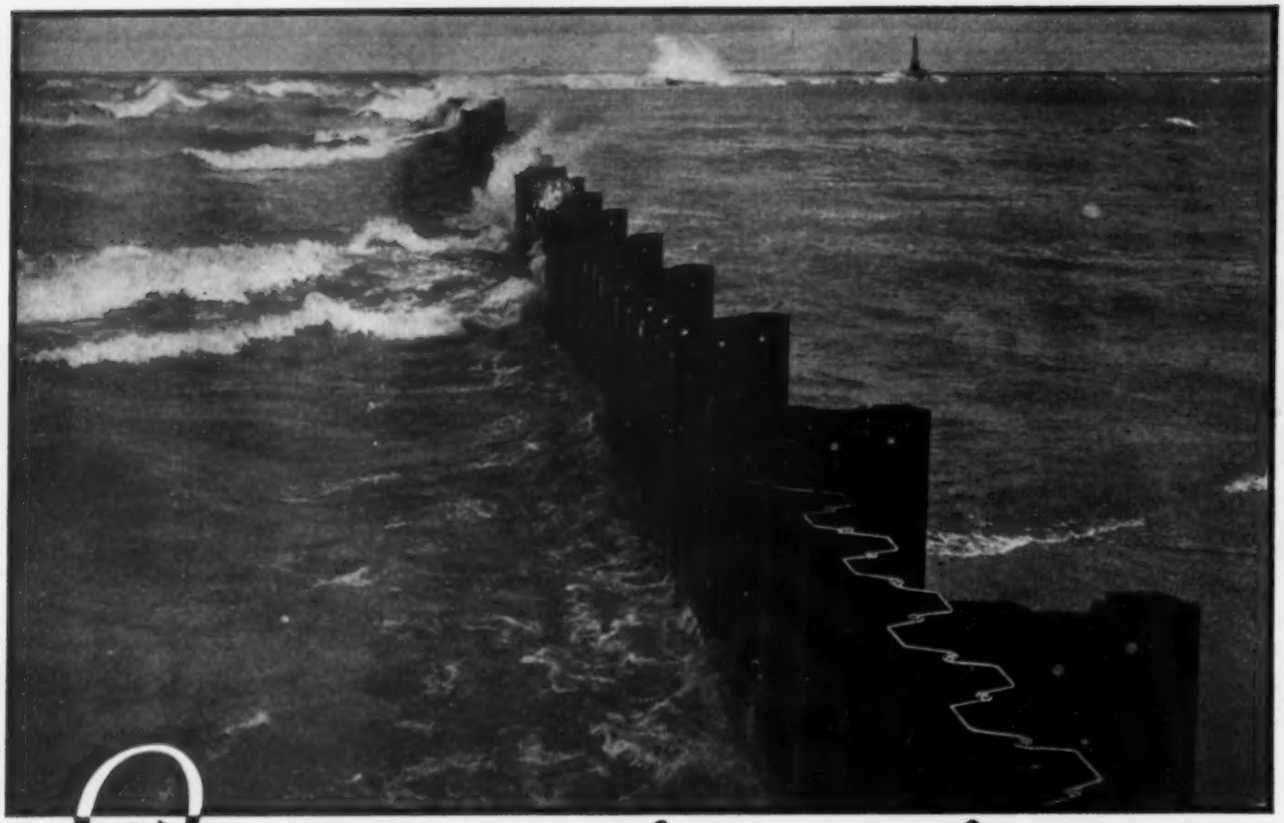
BRUTE STRENGTH

where the going is tough

It's mighty satisfying, as Herkner Co., Cleveland, can testify, to have both constantly on call on a job like the East Pittsburgh highway contract illustrated here. Three Thew Lorains shared in handling 250,000 yards of excavation preparatory to bridge and paving construction. The Thew Shovel Company, Lorain, Ohio.

THEW-LORAIN





"... Nor fear to breast the sea"..

This breakwater at Waukegan, Illinois, designed by U. S. Engineers, Second Chicago District, and constructed by the Luedtke Engineering Company, demonstrates the perfect adaptation of Carnegie Steel Sheet Piling to modern and efficient construction of sea-walls, breakwaters, jetties and piers. A group of practical, well-designed sections, both straight and arch web, cover every possible condition requiring the use of piling. An interlock of especially rugged construction, easy driving and exceptional watertightness characterize all Carnegie Piling sections. CARNEGIE STEEL COMPANY, PITTSBURGH, PA., Subsidiary of United States Steel Corporation.

174

CARNEGIE STEEL SHEET PILING

NOW—ESTABLISH **NEW** AND **LOWER** DIRT MOVING AND GRADING COSTS

Blaw-Knox (Ateco) HYDRAULIC SCRAPER
cutting dirt moving costs on difficult work.

WAGON GRADER

BULLDOZER

TAMPING ROLLER

SCARIFIER

Put your dirt moving costs down where they belong---as low as 5 cents per cubic yard in many instances.

Blaw-Knox Equipment does it.

This impressive line-up of dirt moving machinery is breaking cost records everywhere.

Low in first cost---low in maintenance. Highly efficient---Blaw-Knox Dirt Moving Equipment often pays for itself on the first job.

Let a Blaw-Knox dirt moving expert show you how costs can be lowered on your present contract. Give full details---a sketch will be helpful.

If you don't have a job at the present time, keep this page as a memorandum to write Blaw-Knox when you get one.

Get Blaw-Knox Catalog No. 1310.

Fill in and mail this coupon

BLAW-KNOX COMPANY, 2086 Farmers Bank Building, Pittsburgh, Pa.

Send me complete information about the Blaw-Knox (Ateco) Hydraulic Scraper and the complete line of Blaw-Knox (Ateco) Dirt Moving Equipment.

Name_____

Company_____

Street_____

City_____ State_____

BLAW-KNOX

TIME, TIDE AND CONTRACTS WAIT FOR NO MAN

NO rain checks are issued on construction contracts. The work must go along regardless of unfavorable weather.

Cold weather need be no great hazard if Calcium Chloride is used to protect and speed up concrete work.

Add this safeguard to normal cold weather concrete precautions. Get new concrete out of danger quickly. Speed up the release of forms and protective equipment by getting high early strength concrete with Calcium Chloride.

This important material also makes it possible to keep floor finishers continuously at work—permits concrete pouring and finishing throughout the year. See that Calcium Chloride is included in all concrete specifications. Write for full data on the use of Calcium Chloride for building construction.

CALCIUM CHLORIDE ASSOCIATION

MICHIGAN ALKALI COMPANY
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THE COLUMBIA ALKALI CORP.
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THE DOW CHEMICAL COMPANY
Midland, Michigan

SOLVAY SALES CORPORATION
61 Broadway, New York City

CALCIUM CHLORIDE
FOR SAFE, FAST WINTER CONCRETE CONSTRUCTION

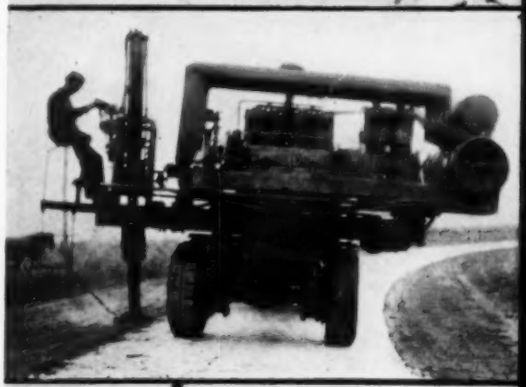
RAPID PAVEMENT BREAKER

TRENCH CUTTER and BACKFILL TAMPER

Breaks up plain or reinforced concrete rapidly. Cuts trench to true line through combination asphalt and concrete or plain concrete. Reduces concrete to backfill size. Reduces concrete roads to size for shoulders or sub-base.

Breaking asphalt and concrete, Lynbrook, L. I., Carmen-Dunne, Inc., Engineers.

Breaking out bridge deck over Reading Railroad at 66th Avenue, Philadelphia, Pa.



Reducing concrete for shoulders, Silliman Godfrey Job, Long Island, N. Y.

Removing railroad bridge deck in 12 hours, Michigan Central Railroad, Detroit, Mich.

We Break Concrete. Demolitioners of

ROADWAYS
TRENCHES
FLOORS
RAMPS
BRIDGES
WALLS
BUILDINGS
or What Have You.

Our estimate is economy to you.

✦

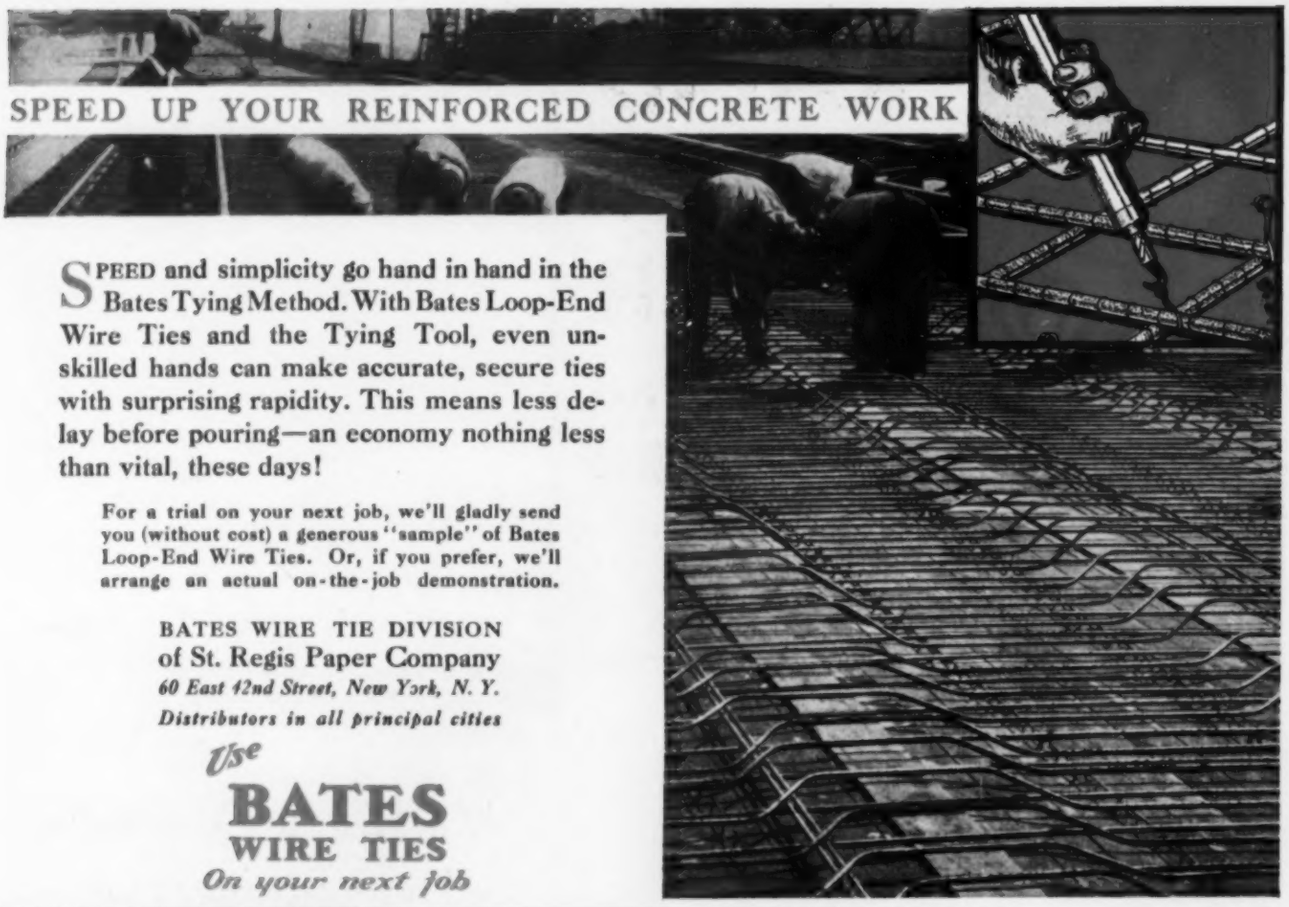
EXCLUSIVE TERRITORY

Control the concrete cutting business in your territory. Exclusive territorial rights for sale to responsible, wide-awake lessees.

✦

CONCRETE CUTTING CORPORATION of AMERICA

52 Clark Street - Brooklyn, N. Y.



SPEED UP YOUR REINFORCED CONCRETE WORK

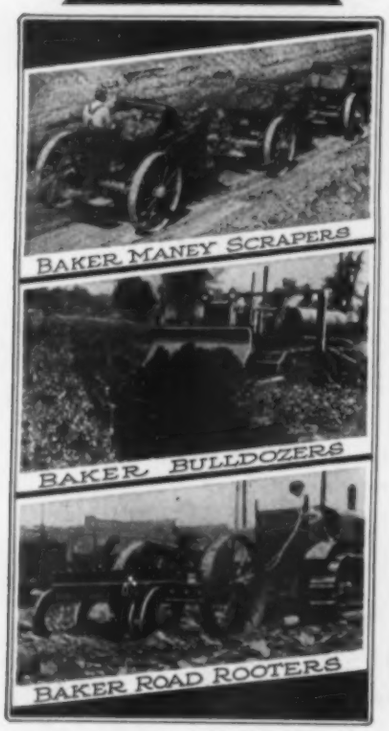
SPEED and simplicity go hand in hand in the Bates Tying Method. With Bates Loop-End Wire Ties and the Tying Tool, even unskilled hands can make accurate, secure ties with surprising rapidity. This means less delay before pouring—an economy nothing less than vital, these days!

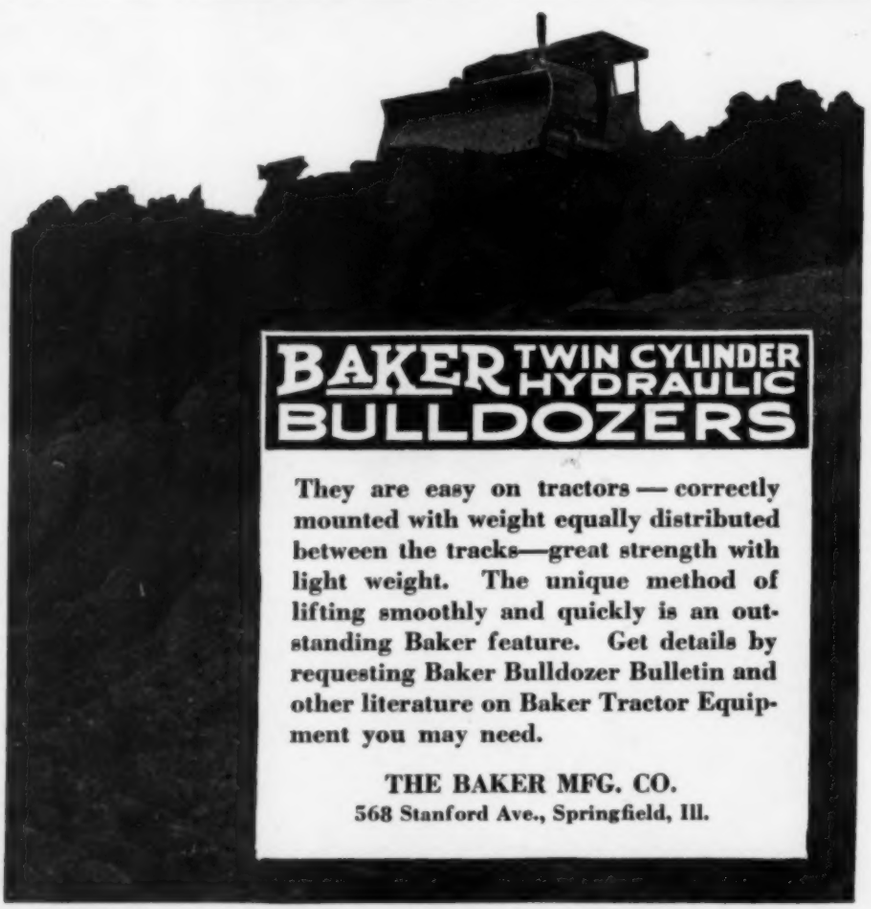
For a trial on your next job, we'll gladly send you (without cost) a generous "sample" of Bates Loop-End Wire Ties. Or, if you prefer, we'll arrange an actual on-the-job demonstration.

BATES WIRE TIE DIVISION
of St. Regis Paper Company
60 East 42nd Street, New York, N. Y.
Distributors in all principal cities

Use
BATES
WIRE TIES
On your next job

BAKER
TRACTOR EQUIPMENT
EARTH MOVING-ROAD MAINTENANCE-SNOW REMOVAL





BAKER TWIN CYLINDER HYDRAULIC BULLDOZERS

They are easy on tractors — correctly mounted with weight equally distributed between the tracks—great strength with light weight. The unique method of lifting smoothly and quickly is an outstanding Baker feature. Get details by requesting Baker Bulldozer Bulletin and other literature on Baker Tractor Equipment you may need.

THE BAKER MFG. CO.
568 Stanford Ave., Springfield, Ill.

WHAT IS Infaration*?

WHAT DOES IT DO?

See next page.

A section of Route No. 2, Steuben County, New York, at Avoca Overhead Crossing. This road is surfaced with Tarmac and has the advantages that come from Infaration.

WHAT Infaration* IS . . . . . .

*Infaration is that quality of a bituminous material which causes effective penetration combined with maximum bonding power.

WHAT Infaration* DOES . . .

Tarmac possesses a combination of two very valuable characteristics . . . (1) the ability to penetrate effectively, with (2) maximum bonding power. Highway officials have been handicapped in the past in describing this important combination because of the lack of a word which covers both qualities in one material. The word "Infaration" has therefore been developed as a necessary addition to the highway engineer's vocabulary.

Some materials penetrate; some bind; but the highway official needs, for his bituminous work, a material that does both.

Infaration is responsible, wholly or partially, for the important advantages of Tarmac . . . such as its skid-resistance; its ability to bind aggregate not ideally clean; the stability of a Tarmac surface. Later announcements will show why Infaration (effective penetration without loss of bonding power) causes Tarmac to be in demand for better bituminous work.

KOPPERS PRODUCTS COMPANY

KOPPERS BUILDING PITTSBURGH, PA.

Tarmac *has* Infaration*

OPERATING COSTS MUCH LOWER

. . . Hastings Transfer Company

THE Hastings Transfer Company is a typical Firestone user. They write: "We have been using Firestone Gum-Dipped Heavy Duty Truck Tires for the last several years; . . . find our operating costs are much lower on Gum-Dipped Tires; . . . a great big asset in helping us to keep ahead of the requirements of modern transportation for fast, safe hauls."

Safety at high speed is built into every Firestone Tire. It comes from basic construction principles not used in other tires.

The patented Gum-Dipping process puts extra flexing life into every cord by insulating each fiber with liquid rubber. Firestone's Two Extra Cord Plies under the Tread add extra protection against punctures and blow-outs—bind tread and cord body together more strongly.

The Firestone Dealer in your community will gladly show you how to materially lower operating costs by changing to FirestoneTires. It costs nothing to talk to him—And doesn't obligate you in the least. See him today.

On your new hauling equipment specify Firestone Gum-Dipped Tires, Firestone Puncture Proof Tubes and Firestone Rims for best service.

Listen to the ***"Voice of Firestone"*** *every Monday night over N. B. C. nation-wide network.*

Firestone TRUCK TIRES

TIRES - TUBES - BATTERIES - RIMS - BRAKE LINING - SPARK PLUGS - ACCESSORIES

Copyright, 1932, The Firestone Tire & Rubber Co.

The Vulcan "PUNCH"

Warrington Vulcan Pile Hammers have been known for their "punch." They have the real driving power that pounds in the piles at record speed,—that makes every blow count.

The secret of their effectiveness lies in the correct apportionment of the weight and velocity of the ram. With a low velocity blow from a heavy mass of ram, most of the energy is actually used to drive the pile. The energy of a light hammer falling at high velocity is mostly absorbed in the pile itself before inertia is overcome and the pile moves downward. The result—damaged pile heads and little penetration.

Warrington Vulcan Pile Hammers are designed on the low velocity—heavy ram principle. Maximum penetration per blow—fewer blows per pile—the Warrington-Vulcan is the hammer with the real punching action that provides economical pile driving.

VULCAN IRON WORKS
327 No. Irving Ave., Chicago, Illinois

Southern Representatives:
Woodward, Wight & Co., Ltd.,
451 Howard Ave., New Orleans, La.

Representatives for California, Nevada, and Japan:
Harron, Rickard & McCone Co.,
1600 Bryant St., San Francisco, Calif.

Representatives for the States of Washington and Oregon:
A. H. Cox & Co., Inc., 1757 First Avenue, S., Seattle, Washington

Warrington-Vulcan
PILE DRIVERS

1200 Tons of LACKAWANNA PILING used by City of New York

for wharf extension at Gravesend Bay, Brooklyn

THIS wharf extension, 1880 ft. long, is of the reinforced-concrete platform type. The reinforced platform was built on timber-bearing piles with a steel sheet piling bulkhead along the rear side.

Lackawanna Deep-Arch Section DP166, in 28- and 32-ft. lengths, was used in constructing the bulkhead. Each steel sheet piling was reinforced with a steel plate, 18 ft., 3 in. long, riveted to the pile web.

There is a Lackawanna Piling Section —Deep-Arch, Arch-Web or Straight-Web —for every purpose. Bethlehem engineers will gladly cooperate with you and suggest the section most suitable for your job.

BETHLEHEM STEEL COMPANY
General Offices: Bethlehem, Pa.

District Offices: New York, Boston, Philadelphia, Baltimore, Washington, Atlanta, Pittsburgh, Buffalo, Cleveland, Cincinnati, Detroit, Chicago, St. Louis, Houston, Dallas.

Pacific Coast Distributor: Pacific Coast Steel Corporation, San Francisco, Los Angeles, Portland, Seattle, Honolulu.

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Allen N. Spooner & Son, Inc.,
General Contractor

BETHLEHEM STEEL

BETHLEHEM

See

the JOB through *with* CARBIC LIGHT

WHEN Carbic Flood Lights are part of your equipment, there is no need to fear the penalty clause or the loss of a bonus, if night work can make up for your delays.

Carbic Flood Lights are compact, self-contained, portable lighting units. Rugged and easy to use, they are always dependable for an emergency. They operate equally well in hot or freezing weather, and in wind, rain, hail or sleet.

Carbic Flood Lights are provided with a filter which frees the gas of moisture and solid particles. Maximum brilliancy of the flame and a constant volume of light are assured. All Carbic Flood Light Reflectors are chromium-plated. They are rust-and tarnish-proof.

These advantages of Carbic Flood Lights are further emphasized by the recent price reductions on Carbic, which total in most zones as much as $30 a ton. This greatly lowered fuel cost coupled with low first cost, makes it economical to use Carbic Flood Lights liberally wherever work must continue after sundown.

Sold by leading jobbers everywhere.

CARBIC

PROCESSED CARBIDE FOR CARBIC LIGHTS & GENERATORS

The new low price of Carbic is $6.00 a drum in Zone 1, $6.50 in Zone 2, and $7 in Zone 3. Write for Zone map.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

126 Producing Plants — UCC — 627 Warehouse Stocks

IN CANADA, DOMINION OXYGEN COMPANY, LTD., TORONTO

District Offices

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LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES • UNION CARBIDE

Cleanup "Champion"

▶FOR UNUSUAL SPEED IN REHANDLING

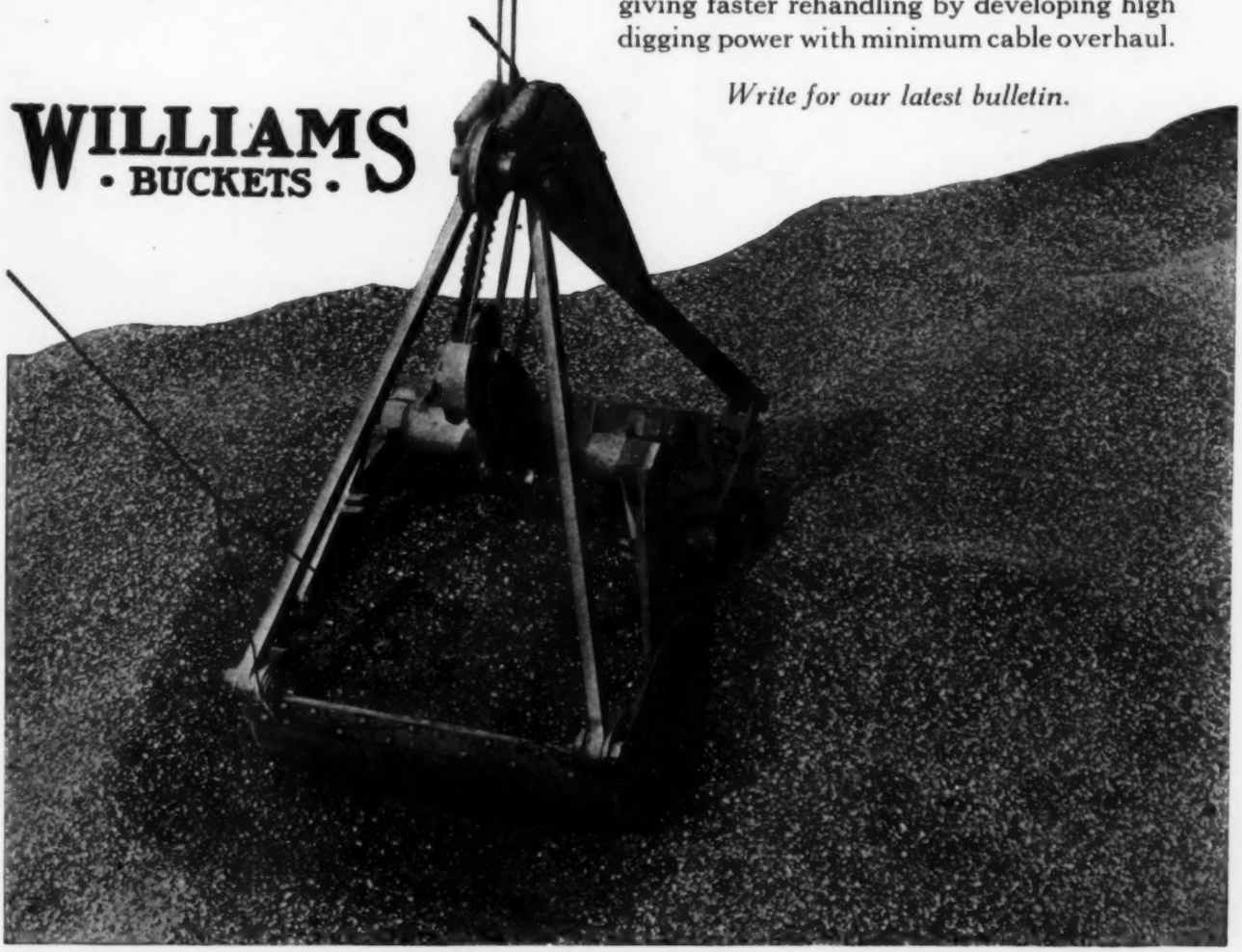
It unloads cars, barges, and cleans up shallow piles of sand, loose gravel, etc., FASTER THAN OTHER REHANDLING BUCKETS.

The Williams "Champion" Cleanup-Rehandler has extra long hinges and scoops that cover a big area — extended corner brackets that give extra digging leverage — narrower and more rigid head.

And it also has the Williams Power-Arm combination of lever and block-and-tackle, giving faster rehandling by developing high digging power with minimum cable overhaul.

Write for our latest bulletin.

WILLIAMS
• BUCKETS •



THE WELLMAN ENGINEERING CO.

7001 Central Avenue, Cleveland, Ohio

Birmingham—New York—Chicago—Pittsburgh—Detroit—Mexico

The RIGHT MOTOR and

HOISTS

For hoisting, this combination of a G-E Type MTC wound-rotor induction motor and suitable G-E drum controller (shown with cover removed) is particularly effective

COMPRESSORS

A G-E 1.0-power-factor synchronous motor operated by a G-E controller is ideal for compressor operation

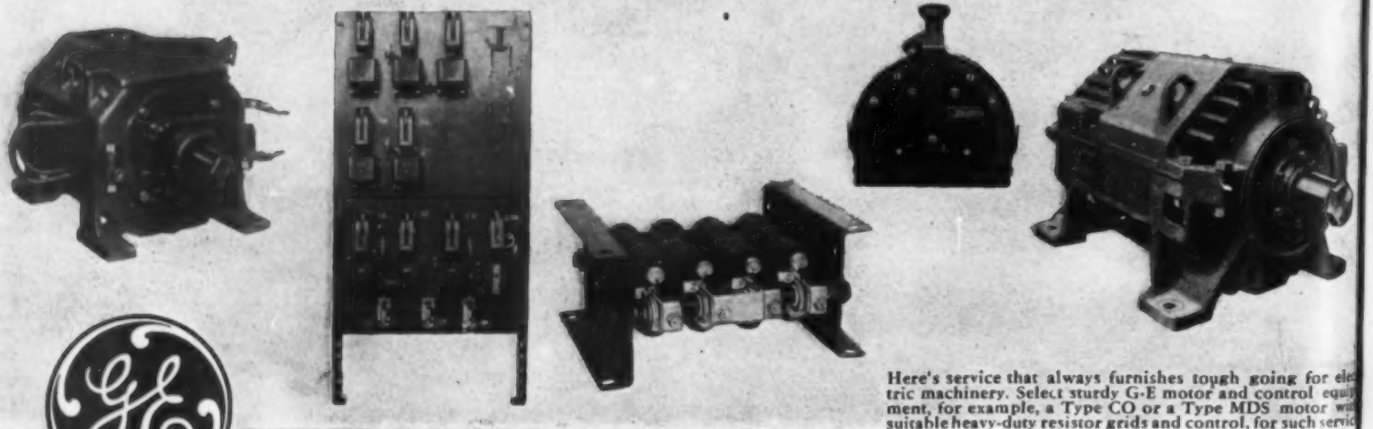
MIXERS

Here's the right motor and the right control set up for your mixer drives — a G-E Type K, totally enclosed, fan-cooled motor and G-E hand-starting compensator

PUMPS AND FANS

For service like this, a Type K motor and a G-E automatic compensator (shown with cover removed) for simplicity

CRANES AND SHOVELS



Here's service that always furnishes tough going for electric machinery. Select sturdy G-E motor and control equipment, for example, a Type CO or a Type MDS motor with suitable heavy-duty resistor grids and control, for such service

JOIN THE "G-E CIRCLE"—SUNDAYS AT 5:30 P. M. E. S. T. ON N. B. C.

GENERAL

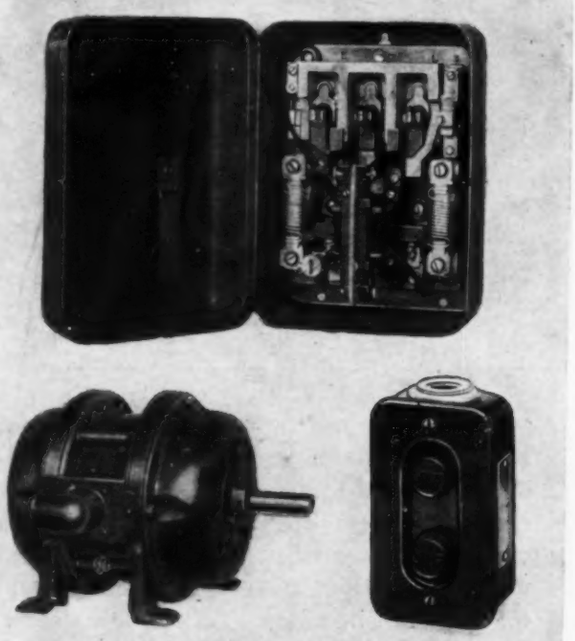
GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

The RIGHT CONTROL
FOR EVERY CONSTRUCTION JOB

REGARDLESS of the job you're doing, or planning to do, whether it be one of erecting a skyscraper office building, burrowing through earth and rock towards completion of a mighty tunnel, or pushing forward a national highway—whatever the task—there's always one motor and control combination exactly suited to the need.

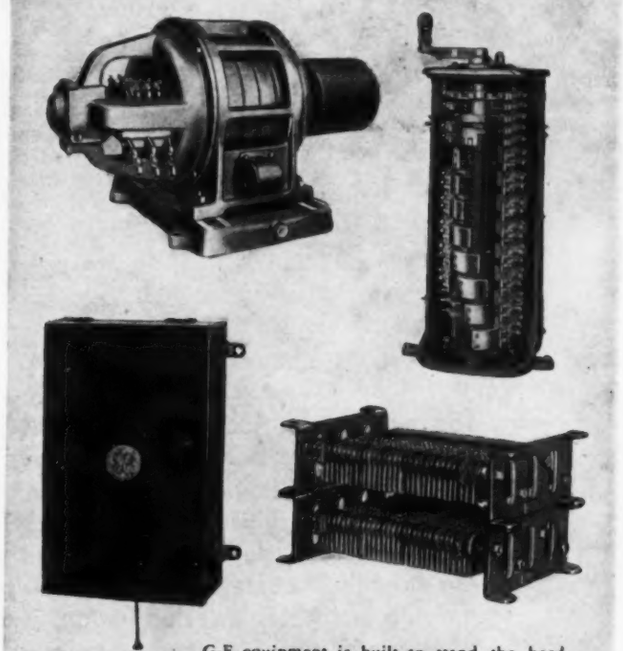
There's always one General Electric combination of the *right motor* and the *right control*—either a-c. or d-c.—that has been designed and built for one purpose: to match the inherent characteristics of the driven machine. That's why G-E motor and control equipment lasts so long, is so free from trouble and expense, is so highly satisfactory—always. Why not investigate this time-proved equipment? There's a G-E office near your operations.

CONVEYORS



Where flexibility of operation is of paramount importance, together with reliability in continuous service, specify a combination like this: a G-E Type KG, high-starting-torque induction motor and a push-button control and magnetic starter

CRUSHERS



G-E equipment is built to stand the hard knocks and overloads of crusher service. There are many effective combinations for service like this; the above, consisting of a G-E wound-rotor induction motor and suitable control, is a suggestion

NETWORK OF 54 STATIONS—WEEK-DAYS (EXCEPT SATURDAY) AT NOON

200-435

ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

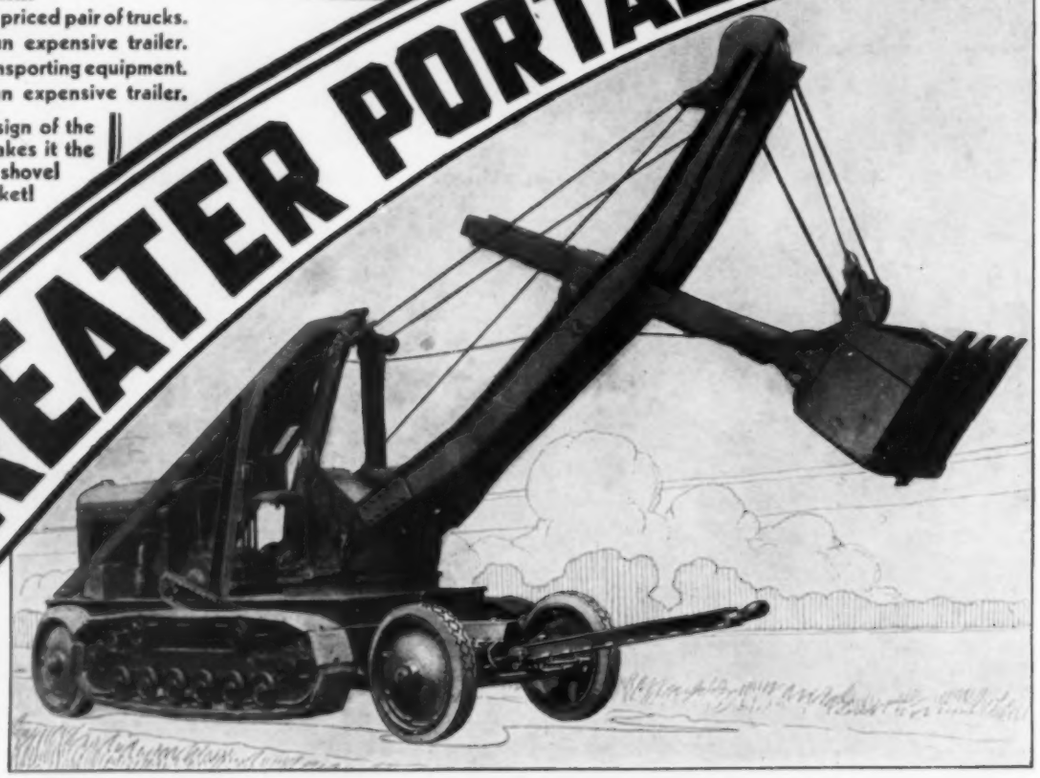
10 MINUTES FOR LOADING!
5 MINUTES FOR UNLOADING!
BLOCKING FURNISHED!

GREATER PORTABILITY

A comparison of five competitive shovels finds the question of portability answered as follows:

AUSTIN BADGER . . offers a low cost pair of wheel mounts.
SHOVEL A . . offers a high priced pair of trucks.
SHOVEL B . . . . . offers an expensive trailer.
SHOVEL C . . offers no transporting equipment.
SHOVEL D . . . . . offers an expensive trailer.

The *improved* design of the Austin Badger makes it the Biggest, little shovel on the market!



Ten minutes for loading, five minutes for unloading, up to twenty-five miles per hour on the road—this greater portability of the Austin Badger is provided at lowest cost.

Other extra values of the Austin Badger are three to five times more roller bearings to provide smoother, faster operation, 1′ 2″ to 2′ 4″ more dumping height, a plus ⅜ yard (11 cu. ft.) dipper capacity, for more yards per day; roller chain crowd and the improved swing gear and turn-table. The Austin Badger is amply powered and fully convertible for crane, dragline or back filler, truly an all-purpose utility tool.

Shipped from spot stocks in twenty-seven cities and backed by seventy-two years of making and selling quality earth moving and road maintenance tools . . . Complete details, prices and specifications sent on request. Also ask for a copy of Bulletin No. 1236.

The Austin-Western Road Machinery Co., 400 North Michigan Avenue, Chicago, Ill.

S-323

The Austin-Western ROAD MACHINERY CO.

ROAD ROLLERS, CRUSHING & SCREENING PLANTS, SCARIFIERS, SWEEPERS & SPRINKLERS, ROAD GRADERS, ELEVATING GRADERS, MOTOR GRADERS, PLOWS & SCRAPERS, ROAD OILERS, ROAD DRAGS, CULVERTS, SHOVELS & CRANES, DUMP WAGONS, SNOW PLOWS.

WHY YOU SAVE MONEY WITH LAY•SET

In ordinary wire rope each wire is like a bundle of springs held under tension. That is why the ends must be securely seized — in order to confine this tremendous internal stress.

It is easily understood why Lay-Set Preformed Wire Rope — in which internal stress is eliminated — gives from 30% to 300% increased service, depending on the type of equipment and nature of the service.

LAY•SET USERS GET 30% TO 300% INCREASED SERVICE

Figure what this substantial wire rope saving means to your producing costs. Add to this saving the expense of recabling, shutdowns, and corresponding loss of production. Here is a total saving that no wire rope user can afford to overlook.

The reason for this increased service is the *elimination of internal stress.* In Lay-Set Preformed Wire Rope, strands and wires are helically shaped and assembled in the form of a rope —each strand and wire fitting naturally in position . . . as contrasted with ordinary (non-preformed) wire rope in which the strands are forced to lie in their helical shapes under stress.

MAKE THIS TEST •

Let us send you a sample length of Lay-Set Preformed Wire Rope. It will come to you with the ends *unseized*— it isn't necessary to seize the ends of Lay-Set because the strands and wires lie normally in place.

Then remove a strand and note its perfect helical shape. Remove also a wire or two from the strand. The rope can then be re-assembled, and you cannot tell which strands or wires were removed.

REDUCE YOUR WIRE ROPE EXPENSE BY 10% TO 70% WITH

HAZARD LAY•SET PREFORMED WIRE ROPE

Mail this coupon today for your copy of "12 Reasons Why You Save Money with Lay-Set Preformed Wire Rope."

HAZARD

Established in 1846

HAZARD WIRE ROPE COMPANY
Wilkes-Barre, Pennsylvania

Send me by return mail your booklet entitled, "12 Reasons Why You Save Money with Lay-Set Preformed Wire Rope." C.M.—3-32

Name .....

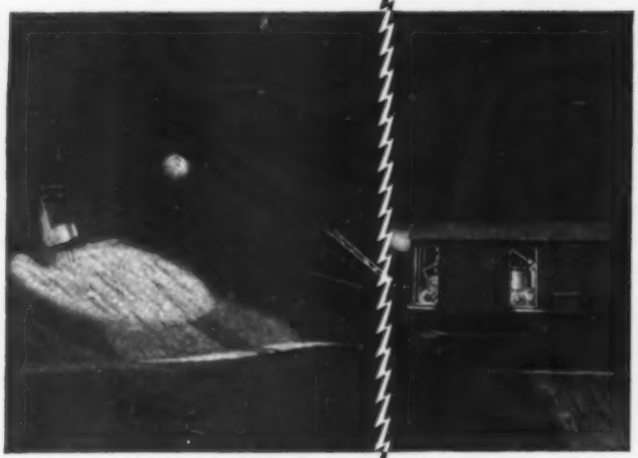
Address .....

Company .....

(Write on margin type of service)

MAIL TODAY

Piling up Yardage —AND PROFITS



Scene on an irrigation project in Mexico where work goes on day and night. This drag-line is equipped with a Bucyrus-Erie engine and a Kohler Electric Plant for electric current.

Kohler Electric Plants generate standard electric current at 110 or 220 volts A.C. or D.C. Capacities vary from 800 watts to 25 K. V. A. The model most popular in excavation work is the EH shown above, protected by a separate hood.

KOHLER Electric Plants enable contractors to make yardage records as well as to regain precious hours lost by unforeseen delays.

The purpose of Kohler Electric Plants in the engineering field is to provide illumination for night work —to keep expensive equipment busy 24 hours a day. Kohler Plants are sturdy and rugged—built to take the jolts incident to shovel and drag-line operation. At the same time they are compact and can be placed on equipment without crowding the operator.

Every one interested in the economies of night operation on earth-moving projects should be thoroughly familiar with Kohler electricity. Send coupon for details and information specialized to the contractor's needs. Kohler Co. *Founded* 1873. Kohler, Wis.—*Shipping Point*, Sheboygan, Wis.—*Branches in principal cities.* Manufacturers of Kohler Plumbing Fixtures.

KOHLER OF KOHLER
ELECTRIC PLANTS

KOHLER CO., Kohler, Wisconsin

Gentlemen: Please send catalog describing Kohler Electric Plants.

*Name*_____ CM-3-32

*Street*_____

*City*_____ *State*_____

*Use in which interested*_____

End costly guessing!

Fairbanks Wheelbarrow Scale used to weigh all ingredients for culvert construction near Bushnell, Ill.

Meet rigid specifications without increasing mixing costs with Fairbanks Wheelbarrow Scale

Contractors everywhere are finding the Fairbanks Wheelbarrow Scale indispensable on every construction job where mixing of concrete must be done with portable equipment. It ends costly guessing. Absolute uniformity is assured when aggregates are weighed on this scale. It saves time. It insures conformance to contract specifications.

One scale with Ingredient Beam does work of two or three ordinary scales. Light weight — easy to handle. Low platform—easy to approach. Sturdy construction withstands hard service. *Complies fully with American Road Builders' Association Specifications.*

There are three types. Complete information furnished without obligation.

FAIRBANKS, MORSE & CO.
900 S. Wabash Ave., Chicago, Ill.
And 40 principal cities—a service station at each house.

Two Ingredient Beam Scale used on bridge job near Decatur, Ill. Note convenient arrangement for rapid weighing.

Fairbanks Wheelbarrow Scale stopped guesswork and saved time on culvert job near Wheeling, Ill.

Fairbanks Scales

Preferred the World Over

5621-SA31.6

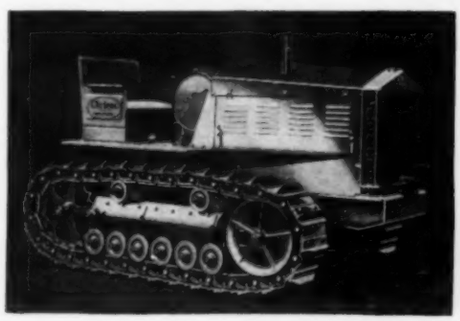
UP with EASE.. DOWN with SAFETY

PHOTO — CLETRACS AT WORK ON A DAM CONSTRUCTION PROJECT IN YUGOSLAVIA

POWER on both tracks—*at all* times! That's the patented and exclusive feature that has built up Cletrac's enviable record for safety and reliability. Planetary differential steering makes the difference.

Up-grade, down-grade or across, a Cletrac is always under perfect control because it is always under "power control." There is no "declutching" of one track to make a turn. There is no disconnecting of power from a track at any time. *At every moment, there is stability and safety.* It is this feature of *constant power* that enables Cletracs to turn as sharply—*and safely*—on a hillside as on level ground.

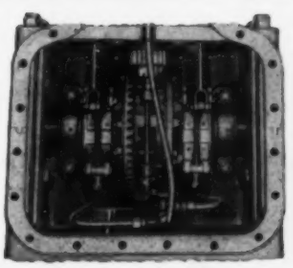
You want power—you want traction—you want endurance—and above all you want *safety*. Whether your job is highway work, earth-moving or any other "power" work, let the Cletrac dealer show you how Cletracs are *built* and *designed* to meet your specifications. See him or write for catalogs and folders.



The Cleveland Tractor Co.
19323 Euclid Ave. Cleveland, Ohio

CLETRAC
CRAWLER TRACTORS

HERE'S THE REASON



There is no disconnecting between engine and track when steering. Instead, a slight movement on the steering lever, decreases the speed on one track and increases the speed on the other by means of a planetary compensating differential, wherein all movements are rolling with a constant film of oil between each element. This results in keeping full pulling power on a load when turning—and assures control and safety on grades.

USE A STOP WATCH— Avoid Costly Delays!

. . . Discover the great savings that are bound to result from time-study and split-second efficiency along every step of construction work . . . Put a stop-watch "on the job"—and it will pay you rich dividends in time and labor saved . . . And—since accuracy is of paramount importance—use a Guinand or a Gallet stop-watch. They are the most dependable Timers you can obtain anywhere. . . Our staff of experts will gladly advise you concerning any specific construction problem. . . Use the coupon below for catalog.

No. 300 *Gallet*
Plain Industrial Timer

Fifth-second, 30-minute register; start, stop and fly back from crown; 7-jeweled, lever movement. Nickel Case.

No. 302 *Gallet*
"Time-Study" Timer

Fifth-second, 30-minute register; fly back from crown; side slide for starting and stopping; 7-jeweled lever movement. Nickel Case.

JULES RACINE & COMPANY

20 WEST 47th ST.
NEW YORK, N. Y.

GUINAND and GALLET TIMERS

JULES RACINE & CO.
20 West 47th Street, New York, N. Y.

Kindly forward your catalog CM on Timers for Industrial Uses. Also send name of dealer in our locality.

Name .....Address .....

City .....Want Timer to Measure.....

. . . . for cooler bearings under any temperature, load or speed

High speeds and heavy loads are no longer a menace to bearings. With Dixon's Cup Grease, friction is greatly reduced by the flake graphite which produces a smooth polish on the bearing surface.

Here indeed is a lubricant as nearly perfect as experience and scientific knowledge can make—a lubricant that combines the quality of mineral oils, the ease and economy of grease, and the efficiency and durability of flake graphite.

Dixon's Graphite Cup Grease is readily available for lubrication without the necessity of bearings heating up sufficiently to melt the grease. It is made in six degrees of hardness to meet all conditions of operation. The additional lubricating quality of flake graphite makes them most economical to use.

Dixon will gladly offer recomendations for the service contemplated. Or, write for Circular 86-R.

Use Dixon's Graphite Cup Grease on:

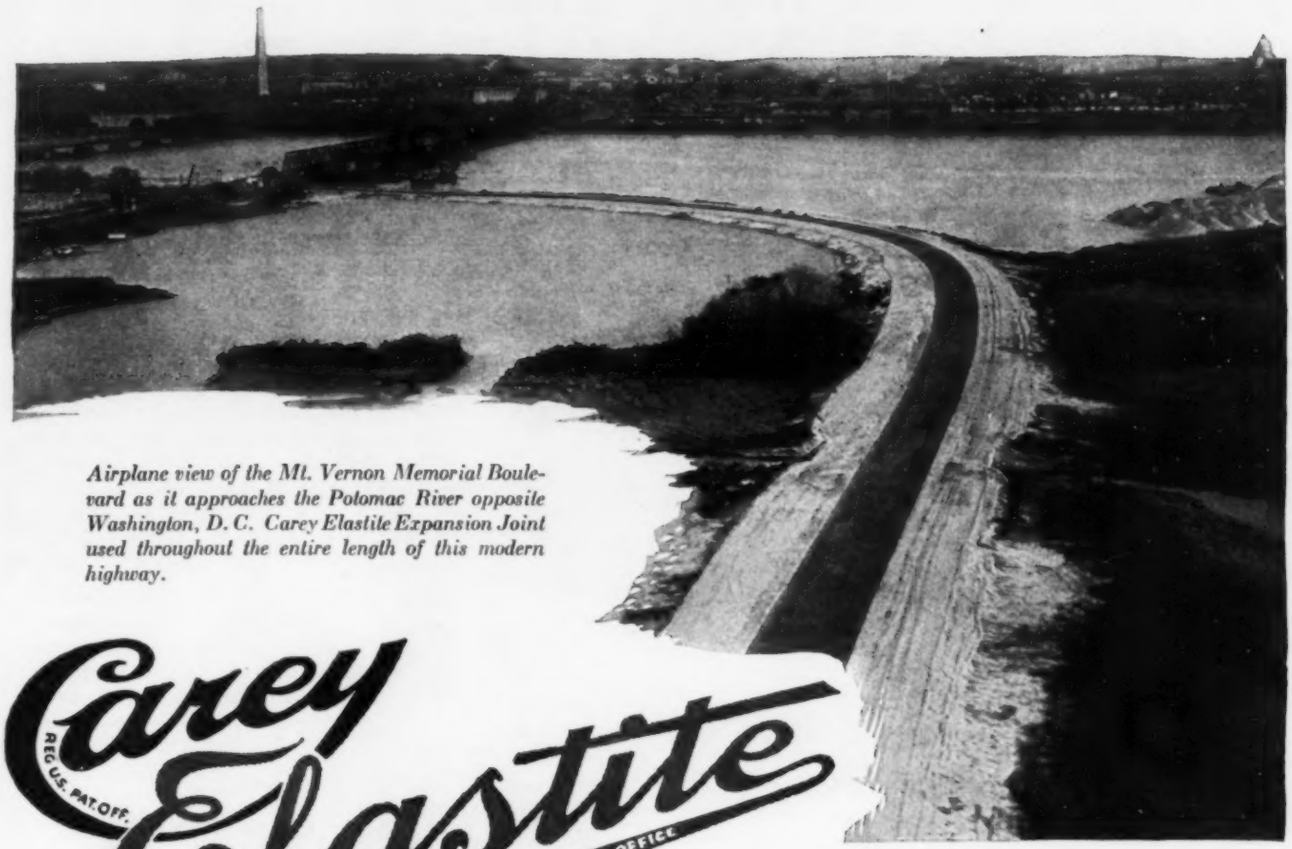
Pumps	Conveyors	Steam Shovels
Compressors	Hoists	Cranes
Engines	Motors	Excavators
Fans		Motor Trucks

for better lubrication

Joseph Dixon Crucible Company

Jersey City **New Jersey**
105 YEARS OF **DIXON SERVICE**

GRAPHITE EXCELLENCE SINCE 1827



Airplane view of the Mt. Vernon Memorial Boulevard as it approaches the Potomac River opposite Washington, D. C. Carey Elastite Expansion Joint used throughout the entire length of this modern highway.

Carey Elastite

REG. U.S. PAT. OFF.

TRADE MARK REG'D. U.S. PATENT OFFICE

EXPANSION JOINT

Protects the Nation's Highways

Materials used in constructing modern highways must be of *proven* quality. Carey Elastite Expansion Joint has been protecting concrete paving against expansion and contraction stresses for over 20 years, and is therefore chosen today for important highways in every part of the country.

Carey shipping service is unusually efficient; large stocks in all centers insure prompt delivery of special as well as standard dimension material. Write for 1932 price list and trade discounts.

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613

Answers to your problems in structural engineering always at your finger tips

EVERY man concerned with the design and construction of civil engineering structures of any type should have these practical books with their helpful tables, diagrams, reference data, best methods and details.

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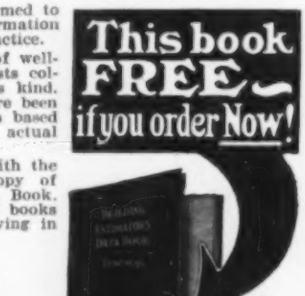

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You may send me **Hool and Kinne's Structural Engineers' Library**, for my inspection. If the books prove satisfactory, I will send $3.50 in 10 days and $3.00 per month until I have paid the price of the books, $27.50. If the books are not what I want, I agree to return them postpaid within 10 days of receipt. Upon receipt of my first payment you are to send me a free copy of **Dingman's Building Estimators' Data Book.**

Signature .....

Home Address .....

City and State .....

Name of Company .....

Occupation .....

(To insure prompt shipment write plainly and fill in all lines.)

C-M-3-32

Increase Shovel Yardage 10%

—Trip the Bucket with the U. S. A. Dipper Trip

Replace the old rope-pulling, back breaking method with this new U. S. A. Universal Semi-Automatic Dipper Trip. A twist of the wrist, and the bucket is tripped—instantly! No tugging at a rope. The operator doesn't leave his controls. And there's no lagging toward the end of the day. Speedy—positive—increases yardage 10%. Made for all standard types of power shovels. The U. S. A. Dipper Trip is compact and easily attached to any make of shovel.

U. S. A. Dipper Trips are optional at extra cost on Marion, P.&H. and Byers Shovels. Other shovel manufacturers are also installing these on new shovels when requested by the buyer. Specify U. S. A. Dipper Trip on your next shovel, and get the extra 10% yardage!

Get complete facts from bulletin—write for it.

Send for Bulletin

MORIN MFG. CO.
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BAY CITY

Model B

⅜ YARD

FULL REVOLVING

The STURDIEST ⅜ YARD on the Market

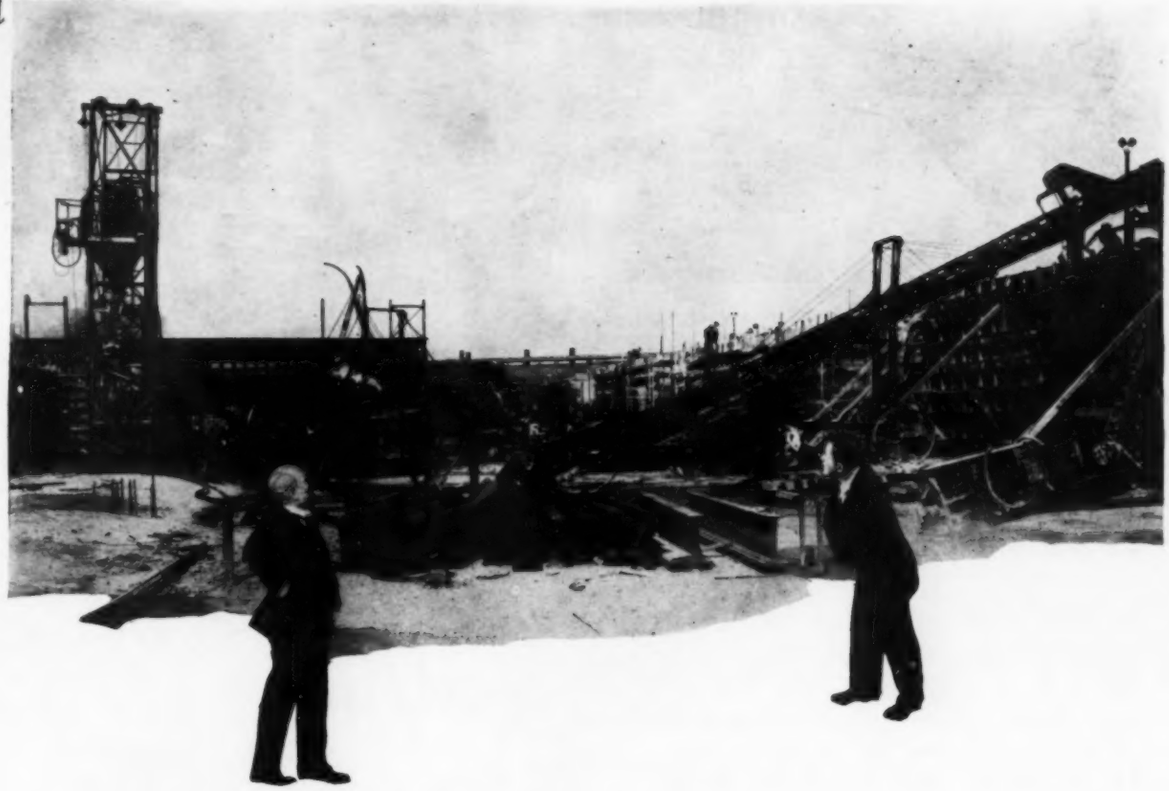
5 other sizes—½ to 1 yd.

CONVERTIBLE

DRAGLINE—TRENCH HOE—CLAMSHELL

BAY CITY SHOVELS, Inc.
BAY CITY, MICH.

A NEW CONCEPTION OF MOTORS IS CONVEYED TO POP AND LAD



"That's the way to handle concrete.

"A Fairfield conveyor carries the cement to the mixer and the concrete goes from the mixer via Fairfields to the forms.

"They tell me that those conveyors are guaranteed to handle a yard of concrete per minute.

"Must take some motor to pull wet concrete along that fast."

"It IS some motor—a Lincoln 'Linc-Weld', hi-torque type.

"It can snap a fully loaded conveyor into action as quick as you can wink your eye.

"Though the 'Linc-Weld' picks up the load faster, it never gets hot and bothered.

"Keeping cool in action means greater efficiency —which applies to both men and motors."

LINCOLN

THE LINCOLN ELECTRIC COMPANY, CLEVELAND, OHIO

Manufacturers of *"Linc-Weld"* Motors and *"Stable-Arc"* Welders

M-3

The Lighthouse of the Highway

FAITHFUL AND DEPENDABLE

The ideal all-weather safety light. A signal that is always seen . . . and always understood.

THE TOLEDO TORCH

IT PREVENTS ACCIDENTS

USE THE TOLEDO TORCH NO OTHER SIGNAL NEEDED SAFETY

The Toledo Pressed Steel Co.
TOLEDO OHIO

Save with Steel

RUGGED REVERSIBLE RATCHET WRENCHES

Husky time and labor saving tools

Send for your copy of complete Catalog R

LOWELL WRENCH COMPANY
WORCESTER MASS.

P&H

Harnischfeger Corporation
Milwaukee manufacturers of Power Shovels, Hoists, Cranes, Draglines, etc.

relies on

Ebonite

for all Heavy-Duty Brakes and Clutches

Re-line with Ebonite XL

SPECIFY *Ebonite XL* for brake re-lining jobs if you want to keep equipment running, for *Ebonite* is outlasting ordinary linings from two to five times and takes a firm, soft grip from start to finish at all working temperatures. That is why leading equipment manufacturers standardize on Ebonite, especially for Boom Hoist Brakes and Swing Clutches—wherever the drag is heaviest and the requirements most severe.

Ebonite not only minimizes re-linings and attendant delays; it saves brake drums as well. Made with more compound (heat conductor) and less asbestos (heat insulator) it spreads surface heat and doesn't develop "hard spots" (crystalized areas caused by excessive localized heat)—the chief cause for brake drum scoring.

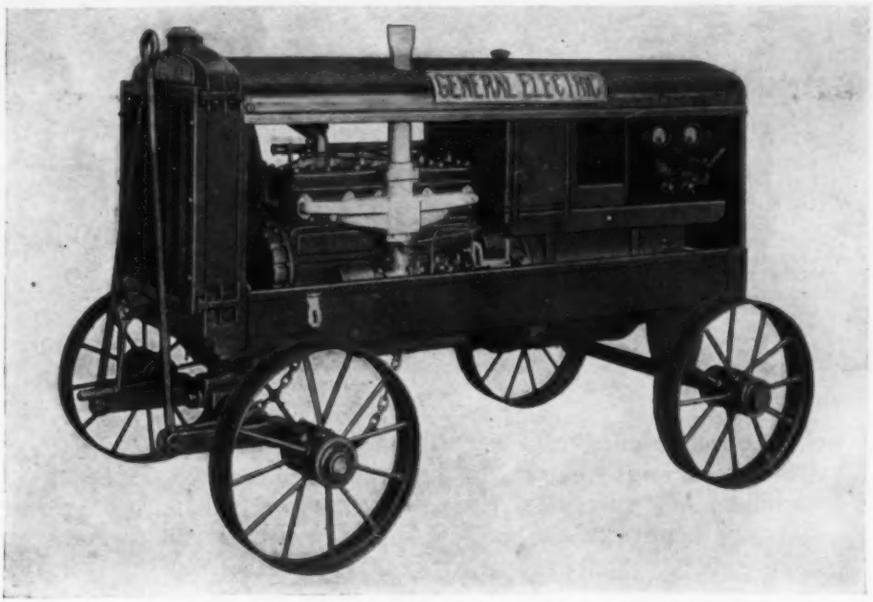
Make This Test!

If you are having brake troubles on a shovel, dragline, crane or hoist, re-line with Ebonite, and be convinced that Ebonite gives better performance in every way. *We guarantee that it will.*

Ebonite Linings, Brake Blocks and Clutch Facings are made in sizes and thicknesses for all cranes, hoists, power shovels, dredges and other construction and road machinery.

L. J. MILEY COMPANY
INCORPORATED
1462 S. Michigan Avenue, — Chicago, U.S.A.

They're Here!-- The New WD Gas-Engine-Driven Arc Welders



The new G-E heavy-duty gas-engine-driven arc welder. Sizes from 200 to 600 amperes

The new welders are provided with removable weatherproof covers, with provision for locking

Various types of running gear are available. Here is a two-wheel spring-mounted trailer with pneumatic tires

THIS new set—a combination of the well-known WD arc-welding generator and a Buda "Hivelo" gasoline engine operating at 1750 rpm.—has been designed, mechanically, for especially heavy duty.

The deep, rigidly welded bases, strong running gear, ample cooling capacity, extra-strong mechanical parts, and rubber-mounted, glass-shielded instruments are particularly adapted for the requirements of the construction field—tank farms, bridges, buildings, etc.—and for the severe requirements of pipe-line welding where the use of heavily coated electrodes may require voltages as high as 40 volts.

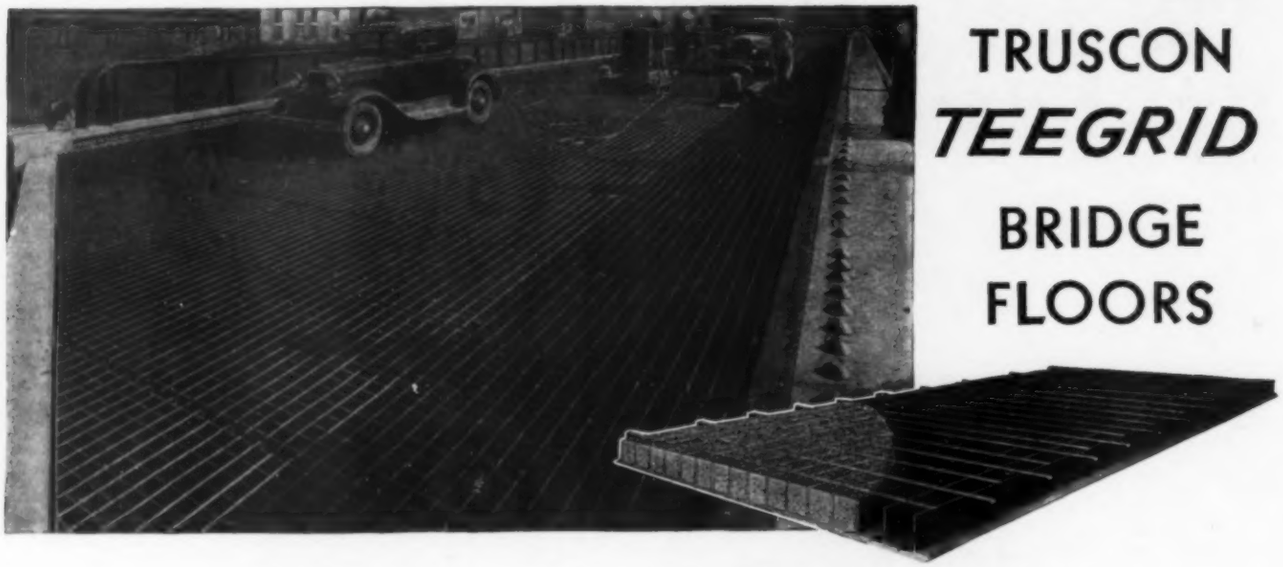
Investigate this new line of General Electric gas-engine-driven arc welders. For further information, ask your nearest G-E office or welding distributor for a copy of Descriptive Bulletin GEA-1543.

530-122

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

Extra Strength with Minimum Dead Weight!



TRUSCON *TEEGRID* BRIDGE FLOORS

The perfect solution of bridge floor problems. Great strength with minimum dead weight. Simplified, speedy erection. Absolute continuity of material and load distribution. Eliminates field "forms" for concrete and provides a steel-armored wearing surface.

Write for complete data.

TRUSCON STEEL COMPANY, YOUNGSTOWN, OHIO

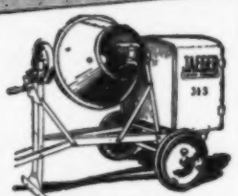
TRAFFIC *rolls along uninterrupted when* HYDRAUGER *is on the job*

The use of Hydrauger for installing underground piping is a courtesy which is appreciated by the public. As pavement cutting is avoided traffic hazards are likewise eliminated. Besides Hydrauger works more economically than the obsolete methods of trenching or pipe-jacking. Hydrauger bores a straight clean hole through which piping can be easily installed. The many now in use prove their efficiency and low-cost operation. Our latest catalogue will be sent on request.

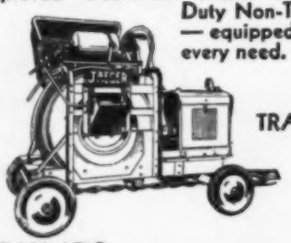
HYDRAUGER CORP., Ltd.
1298 Bryant St. • San Francisco
Distributors in Principal Cities

HYDRAUGER
"The Mechanical Gopher"

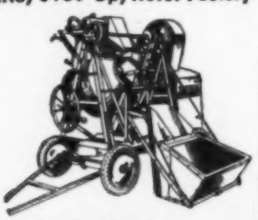
. . . . JAEGER EQUIPMENT *offers More for your Money*



MIXERS: 3½S to 84S sizes. Improved "Dual-Mix" Tilters. Heavy Duty Non-Tilters — equipped for every need.



TRAILERS, $169 Up, f.o.b. Factory



PUMPS: More capacity and power, less weight, lower prices. All sizes, types, 10,000 gal., 2" Self-Prime Centrifugal, complete with 4 cycle engine and strainer. $181.00 f.o.b. factory.

HOISTS: Timken Screw Thrust, powerful, fast, easy to operate.

All sizes.

THE JAEGER MACHINE CO.
800 Dublin Ave. Columbus, Ohio

GET OUR PRICES ON MIXERS, PUMPS AND HOISTS

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Positions Wanted, 5 cents a word, minimum $1.00 an insertion, payable in advance.

Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.

Proposals, 50 cents a line an insertion.

INFORMATION:

Box Numbers in care of any of our offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

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1 inch.....$6.00
2 to 3 inches..... 5.75 an inch
4 to 7 inches..... 5.50 an inch

Other spaces and contract rates on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

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Philadelphia, Pa., 1015 Chestnut St.
Boston, Mass., 31 State St.
Tampa, Fla., 315 Tampa St.

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1—Factory rebuilt P.&H. Model 600, 1-yd., 21-ft. bm., new 1928, rebuilt 1932, guaranteed.
1—Factory rebuilt Lorain-75, 1¼-yd., like new.
1—Bay City full rev., ¾-yd. Cats. 1929.
1—Bay City full rev., ½-yd. Cats. 1930.
1—Factory rebuilt Universal-35, ½ yd. Dipper.

STEAM SHOVELS

1—41-B Bucyrus-Erie No. 10560, Nat. Bd. Mass. boiler, 1¼-yd., used 7 months, 1930, like new.
1—Thew A1, No. 2498, Center Drive Cats., 1-yd.
1—Type B Erie, ¾-yd. Cats., new 1926.
1—Marion Model-70, R.B. type, full Cats., A.S.M.E. Boiler, 3¼-yd., 1925, A1 cond.

CRANES

1—12-ton cap. Byers, Gas, New 40-ft. bm., 1928, factory reconditioned 1932, guaranteed.
1—24-ton cap. Bucyrus-Erie Steam Crawler, 58-in. Nat. Bd. Boiler, 150 lb., 50-ft. bm., 1930.
1—7-ton cap. Universal-35, 28-ft. bm., 1929.
1—6-ton cap. Universal Truck-Crane, 1930.
1—20-ton cap., 8-wheel, Lorain Gas Loco. Crane, 50-ft. bm., 1930, guaranteed.

Attractive Terms of Payment. Now is the time to buy.

Grey Steel Products Co., Inc., 30 Church St., New York. COrtland 7-0604

THE GREY LINE

SHEET STEEL PILING

BOUGHT — SOLD — RENTED — RE-PURCHASED

NEW and USED

1 Length or 10,000

Most economical Sections rolled.

Stocks at principal points throughout the country for prompt shipment.

L. B. FOSTER CO.

NEW YORK PITTSBURGH CHICAGO

CIVIL SERVICE OPPORTUNITIES

State Unwritten Examination application forms may not be issued by mail after March 17, and may not be accepted after March 19.

ENGINEER (Water Works), Department of Public Service, State Division, Public Service Commission. One immediate appointment expected at $6,000.

County Written Examination application forms may not be issued by mail after March 17, and may not be accepted after March 19.

County Written Examination application forms may not be issued by mail after March 17, and may not be accepted after March 19.

HEAD FOREMAN, Onondaga County Highway Department. Salary $2,100 to $2,640. One immediate appointment expected at $2,100.

SALESMEN AVAILABLE

SALESMAN, calling on plumbing and heating dealers, architects, etc., in Wilkes-Barre, Pa., and vicinity for fifteen years, is available for side lines.—Building hardware specialties, etc. SA-104 Constr. Methods, 330 West 42d St., New York.

ALPHABETICAL INDEX TO ADVERTISERS

This index is published as a convenience to the reader. Every care is taken to make it accurate, but *Construction Methods* assumes no responsibility for errors or omissions.

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